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W. J. JOHNSTON, Editor and Publisher.

T. COMMERFORD MARTIN, JOSEPH WETZLER, Associate Editors.
G. H. STOCKBRIDGE, Assoc. Editor Patent Department.
CLARENCE E. STUMP, Business Manager.
WALTER T. HUNT, Advertising Dept.

New England Office, 48 Congress Street, Boston.
W. I. BARKER, Manager.
Western Office, 44 Lakeside Building, Chicago.
C. H. MACLILIE, Manager.

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New Advertisements.

In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue:

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VOL. X. NEW YORK, AUGUST 20, 1887. No. 8.

WHILE the production of electricity through the medium of the steam engine and the dynamo has been recognized as a great advance and has laid the foundation of the present work in electric lighting and the transmission of power, the dream of inventors for many years past has been the production of electricity direct from the heat of the combustion of coal. It has long been evident that the thermo-electric pile was open to but little improvement, and also that some other principle than was employed there must govern the action of a successful pyroelectric generator. The paper presented by Mr. Edison before the American Association for the Advancement of Science, and printed on another page, shows what must be considered a practical solution of this problem. Mr. Edison takes advantage of the property of magnetic metals, in virtue of which they lose their magnetism at high temperatures, to cause a fluctuation in their magnetic strength, which induces currents in coils surrounding the metal. Though the machine sufficient to furnish currents for the lighting of a good-sized house is rather bulky in its present form, there can be little doubt that radical improvements will reduce its weight. Even now, however, Mr. Edison is confident that it fulfills the requirements of a domestic electric generator, requiring practically no attention and affording the incidental advantage of a furnace for the heating of dwellings.

A BANNER NUMBER.

From time to time we have had occasion to call the attention of our readers to the growth of THE ELECTRICAL WORLD, and the comparisons between present and past have been striking. It has always seemed at each stage that high water mark must surely have been reached, but the future has still held out the promise of greater results as the return for just a little more effort, and so the paper has gone onward and upward. Thus it is that this week we are able to point to an issue of no fewer than 56 pages, making it by far the largest number ever printed of any electrical journal. Pride in such a paper is pardonable, we think, especially when it is shared with thousands of friends and readers who have observed with kindly praise and comment the growth of THE ELECTRICAL WORLD, and who find in its record some exemplification of their own progress and careers. It goes without saying that a paper of this size and character must be in every way broad-based, and that it is regarded by those who study its reading pages or use its advertising columns as thoroughly representative and trustworthy. THE ELECTRICAL WORLD permits no limitation of its range or sphere of work, but is alive to the development of electricity in every department, and has its readers as well in China as in Africa, and not only in Asia Minor and India, but in every section of North and South America—in short, wherever throughout the world there is interest felt in electrical matters—wherever the telegraph, the telephone, the electric light, the electric motor, the storage battery, or any other kind of electrical apparatus is in use. The universal recognition accorded THE ELECTRICAL WORLD has been won by assiduous and conscientious work, and the position thus gained will be held by the same means that have brought the paper to its present leadership in the field of electrical journalism.

THE SIXTH MEETING OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Our columns are largely occupied this week with the report of the Boston meeting of the National Electric Light Association. It will be seen that the papers and discussions were interesting, that the attendance was the largest yet noted, that the display of novelties was far more elaborate and comprehensive than usual, and that the hospitality extended to the members was unbounded.

A brief notice of the principal matters brought before the convention will not be out of place. To begin with the wire gauge then, it may be remarked that the Association has acted wisely in declining to put forward another gauge. What a long suffering public wants is not more gauges but fewer. Thanks to the intelligent labors of the Gauge Committee of the Association, we are now in possession of a most valuable table, and the money spent on that is well invested. It is true that the motion to make a new gauge compulsory was lost, but the ventilation of the subject has not been without its good effect. When the metric system comes into more general use, as it will some day, the value of the table compiled will be the better appreciated, and meantime the Association has been prudent in adopting the resolution presented by Mr. G. M. Phelps, Jr.

In anticipation of requirements that must be filled as the new navy takes shape, the Navy Department has done well in affording Lieutenant Murdock an opportunity to lay before electrical engineers and the manufacturers of dynamo-electric machinery the conditions which ship plants must meet. Compactness and lightness are, as he shows, prime considerations. They can only be secured, however, first by the direct connection of engine and dynamo, and secondly by a special design for the latter machine. It is evident, as regards the first point, that for the special purpose in view the slow speed dynamo is the best; belting and other methods of coupling present serious objections on board ship. As to special designs, much might be said with pertinence. The energy in watts per pound of machine and per square inch of floor space, as cited, is interesting, but the all-round merits of the different machines cannot be judged hastily on that basis alone. It is more than probable that while some of the foreign dynamos were planned for ship work others were not; and touching dynamos of domestic manufacture, it may fairly be urged that, lacking a navy, there was little inducement to enter upon the special work which such a fleet as that of England affords great opportunity for and can render highly remunerative. Again, the efficiencies of the machines are not given, and it is well known how that element varies with the quantity of iron, *i. e.*, with the weight of the machine. Hence, the data given is useful rather for its suggestiveness than for its indication of an absolute standard. We can cordially recommend Lieutenant Murdock's weighty paper to our electrical readers for careful study, and it would not be amiss for engine builders also to note what is expected of of them.

Two points in the paper relate to the proper potential for ship-lighting circuits, and the type of machine yielding the right current, and between these details there is an intimate connection. It is obviously desirable on a man-of-war to operate both incandescent lamps and arc lamp projectors from the same circuit. Lieutenant Murdock, it will be seen, advocates 70 volts as the potential best adapted to the requirements of both systems. It is to be remembered that the shortness of the circuits in this case puts beyond serious consideration the weight of the copper, although elsewhere that would be a leading factor in the calculation. The potential named is, moreover, very nearly that required for the arc search light. Taking the character of the work and the liability to sudden and heavy fluctuations in current into account, the compound dynamo seems, according to Lieutenant Murdock, to be fittest for the purpose. The Government does well, too, in calling for a very high insulation of the leads and in insisting upon the double circuit system, instead of permitting the use of the skin of the ship as a return. This latter practice we have before criticised as dangerous. It not only provokes fires, but we believe that it sets up electrolytic action which, in time, serves to decompose the iron plates and to cause their destruction.

It cannot be said that the report and discussion on alternating currents brought out much that was new, but they showed the advance made by the alternating system in practice and in populatity. The system is here to stay, and though all the claims made for it have not yet by any means been substantiated, it has proved its right to existence and its ability to fill a distinct and large field of operation. There is a feeling among electricians that the alternating current is destined to do good work not alone in lighting, but in welding and in various services to which the phenomena recently described by a distinguished investigator point very clearly. We are on the threshold of a number of new applications in this single department.

The papers of Mr. Mailloux and Mr. Reckenzaun were alike good, and the one was the complement of the other. It is noteworthy that the subject handled in them was the only one that called forth a leading article in the Boston daily papers, and though the use of storage batteries for street car work has hitherto been a little beyond the Association's purview, it is clear that a marked benefit was done by having so public a treatment of this important subject. The facts elicited were significant and encouraging, and electric light men will not be slow in appreciating them.

More time might well have been spared to Mr. Weeks' thoughtful paper on electrical education. It is not at all uncommon for a local company now to have from fifty to a hundred men in its employ, and the training that shall be given to such a force, clothed with responsible duties, is no trivial matter. Time and money spent on the education of a station staff is recouped ten times over, and we think that it would have been profitable to every one to have participated in a friendly discussion on the wisest plan to adopt for training men, and to have heard from Mr. De Camp and Mr. Law of their educational work in Philadelphia, from Mr. Weeks of his own work in Kansas City, and from others similarly engaged in Boston, Baltimore, New York and other places. Still, the subject can be taken up again, and should not be lost sight of.

The continued growth and increased usefulness of the Association cannot but be a gratification to all who have shared in its work from the outset, and it must be a source of special pleasure to the president. While many have contributed to the advancement of the body, Mr. Morrison would be quite justified in regarding its present size and influence as a personal success. In a position that at first very few would have cared to hold, when the Association was young and struggling, but which to day is a foremost one in the electrical profession, Mr. Morrison has shown an executive ability of the highest order. The office has been one in filling which it was easy for a man to make hosts of enemies and in which, for that matter, one of his temperament might have experienced peculiar difficulties, but the warm esteem with which the president is regarded by all the members is richly deserved and has been earned by conspicuous zeal, fidelity, force and impartiality.

Meeting of the National Electric Light Association.

The meeting was called to order by President Morrison at 10.30 A.M. on August 9, at the Parker House, Boston.

The names of those in attendance during the three days are given below:

NEW YORK.—P. C. Ackerman, C. H. Barney, W. H. Blake, A. W. Butterworth, C. S. Bradley, E. Bynner, W. L. Candee, F. G. Cartwright, Wm. F. Cullen, W. M. Callender, Addison Conkling, H. N. Curtis, Isaac H. Davis, Henry C. Davis, F. C. Dowd, P. A. Dowd, C. L. Edgar, J. B. Edson, E. F. Gennert, M. W. Gleason, M. W. Goodyear, John H. Hapgood, J. M. Hill, C. B. Hotchkiss, H. McL. Harding, F. E. Kinsman, W. C. Kerr, A. A. Knudson, H. F. Lufkin, E. T. Lynch, Jr., Z. Latshaw, C. O. Mailloux, Geo. T. Manson, T. C. Martin, Romaine Mace, Dr. Otto A. Moses, Norman McCarty, Frank A. Magee, Jno. M. Pendleton, Chas. W. Price, Ralph W. Pope, Geo. M. Phelps, Jr., R. W. Ryan, L. Searing, C. E. Stump, A. C. Smith, G. H. Stockbridge, W. I. Wark, Joseph Wetzler, H. Wellington, G. L. Wiley, S. S. Wheeler, A. P. Wright.

BOSTON.—P. H. Alexander, Geo. W. Adams, Wm. T. Andrews, H. W. Burgett, W. I. Barker, N. H. Barker, G. H. Blodgett, Aaron D. Blodgett, G. W. Blodgett, Edward Blake, L. W. Burnham, Oscar S. Bussmann, E. H. Batcheler, Wm. Brophy, Chas. E. Bibber, F. J. Boynton, J. M. Betton, H. B. Cram, C. A. Coffin, Albert H. Chapman, H. A. Clark, F. E. Cabot, Frank E. Clark, T. W. Clark, J. H. Churchill, G. W. Davenport, G. W. Daniels, A. T. C. Daniels, T. B. Doolittle, ——. Davis, Jas. F Dodge, Samuel Elder, H. H. Eustis, Charles Fuller, Frank Fuller, H. M. French, W. D. Finley, T. C. Frenyear, —— Francis, B. S. Flanders, Robt. G. Fitch, E. I. Garfield, J. N. Godfrey, F. A. Gilbert, A. V. Garratt, C. N. Goward, Alex. S. Hayes, W. B. Hosmer, W. S. Hill, W. A. Hall. O. N. Howland, J. B. Hatch, Jr.; G. H. Hartwell, William O. Howland, —— Hutchings, Charles L. Ireson, J. Jacobs, E. W. Kellogg, W. R. Keifer, F. H. Kimball, J. L. Kimball, D. Killecutt, D. W. Lee, Thos. D. Lockwood, Thos. Leavitt, W. C. Livermore, A. F. Mason, C. J. Messer, S. P. Messer, W. H. Mendell, Irving S. Meredith, A. G. McCluir, J. B. Martin, Edmund Noble, Hon. Hugh O'Brien, Walter J. Paine, S. B. Paine, Albert C. Pond, W. E. Park, H. B. Prindle, H. G. Pratt, A. L. Russell, G. L. Richards, C. M. Ransom, R. F. Ross, E. J. Richards, M. F. Rogers, G. Richardson, G. S. Ross, Chas. W. Rand, Fred. Schlegelmilch, E. P. Sparrow, Leopold Schlegelmilch, Fred. J. Sawyer, — Sherburne, J. S. Sawtry, F. W. Sanderson, P. Sullinger, A. T. Starkey, W. M. Turner, G. F. Talcott, F. H. Thompson, H. J. Toland, H. S. Thornberry, A. F. Upton, S. P. Wardell, L. B. Wright, E. H. Williams, Geo. W. Waite, C. J. S. Woodbury, Henry J. Weil, J. J. Williamson, C. D. Wainwright, H. C. Wirt.

PROVIDENCE, R. I.—Geo. H. Adams, F. H. Bradford, C. E. Bailey, E. M. Carhart, W. A. Huse, Henry B. Lytle, Marsden J. Perry, E. F. Phillips, R. T. Robertson, W. H. Sawyer, C. Sims, R. H. Whittier.

CLEVELAND.—W. H. Boulton, C. A. Brayton, J. B. Crouse, D. A. Dangler, E. B. Gethin, Webb C. Hayes, Wm. Henderson, W. H. Lawrence, J. J. Miller, Geo. W. Mansfield, F. E. Pettingill, E. F. Peck, Geo. W. Short, Wm. F. Swift, C. D. Smith, C. L. Wright.

CHICAGO.—G. W. Atkinson, S. A. Barton, Geo. S. Butte, Henry Bowen, W. J. Buckley, A. H. Brown, D. Gilbert Dexter, H. S. Glasier, F. W. Harrington, W. A. Kreidler, J. H. Shay, F. H. Soden, J. N. Thomas.

PHILADELPHIA.—W. B. Buchanan, A. J. De Camp, N. H. Edgerton, S. B. Hillman, Harry Hall, Stephen F. Holbrook, M. D. Law, Edwin C. Mullin, James A. Pentz, Anthony Reckenzaun, W. E. Sharpe, —— St. Clair.

NEW HAVEN, Conn.—J. H. English, Will Hooper, Frank N. Hooper, C. D. Warner, Dr. Leonard Waldo.

BALTIMORE, Md.—Wm. Baxter, Jr., J. W. Darley, D. E. Evans, B. M. Greene, W. H. Harding, P. O. Keilholtz, J. Frank Morrison, Thos. McCoubray, Jr., M. N. Packard, Arthur Steuart.

LYNN.—V. R. Jones, A. H. Jones, E. W. Rice, Jr., W. M. Rand, A. L. Rohrer, Prof. Elihu Thomson.

BROOKLYN, N. Y.—C. Cooper, J. Flint.

NORTHAMPTON, Mass.—A. M. McCallum, C. H. Pierce.

NORTH ADAMS, Mass.—C. G. Richmond.

NORTH ATTLEBORO.—H. M. Daggett, Jr., L. W. Dillon.

CAMBRIDGEPORT, Mass.—C. B. De La Vergne, E. H. Mulliken, Leonard Schaefer.

NEW BEDFORD, Mass.—G. Allen, Wm. Lewis, R. B. Taber.

KANSAS CITY, Mo.—T. P. Bailey, C. S. Rusling, E. R. Weeks.

WOBURN, Mass.—M. M. M. Slattery, N. J. Simons, J. E. Talbot.

WASHINGTON, D. C.—J. C. Edwards, R. W. Prentiss, Frederick W. Royce.

PITTSBURGH, Pa.—S. A. Duncan, W. C. Kerr, Geo. F. Porter, T. C. Smith.

HARTFORD, Conn.—J. H. Dalzell, M. J. Wightman, Chas. K. Wead.

DETROIT, Mich.—W. W. Leggett, J. M. Smith.

BUFFALO, N. Y.—W. S. Frear, A. A. Noye.

NEWARK, N. J.—C. O. Baker, Jr.

PORTLAND, Me.—C. A. Brown.

NEW BRITAIN, Conn.—Thos. S. Brady.

MALDEN, Mass.—A. E. Bliss.

WATERBURY, Conn.—G. M. Chapman.

NEWTON, Mass.—H. H. Cutler.

JAMESTOWN, N. Y.—W. R. Caulkins, T. H. Smith.

NORFOLK, Va.—Wm. W. Chamberlain.

POUGHKEEPSIE, N. Y.—J. N. Candee.

READING, Mass.—W. B. Dowse.

WORCESTER, Mass.—H. H. Fairbanks.

LIVERPOOL, Eng.—W. H. Fleming.

CHELSEA, Mass.—F. M. Gilley.

NEW ORLEANS, La.—S. J. Hart.

GARDINER, Me.—P. H. Holmes.

SAVANNAH, Ga.—T. P. Keck.

U. S. NAVY.—Lieut. J. B. Murdock.

BRIDGEPORT, Conn.—F. A. Mason.

NEWARK, N. Y.—C. McIntire.

BIRMINGHAM, Conn.—Chas. Nettleton.

CHARLESTOWN, Mass.—G. B. Neal.

PATERSON, N. J.—J. F. Noonan.

ST. LOUIS, Mo.—G. W. Parker.

DULUTH, Minn.—J. F. Patten.

SAN FRANCISCO, Cal.—Geo. H. Roe.

FORT WAYNE, Ind.—P. A. Randall.

E. CAMBRIDGE, Mass.—S. O. Richardson, Jr.

ST. LOUIS, Mo.—Dan. R. Russell.

BRIDGEPORT, Conn.—H. D. Stanley.

ST. JOSEPH, Mo.—W. C. Stewart.

SYRACUSE, N. Y.—A. P. Seymour.

WALTHAM, Mass.—A. Webster.

SOMERVILLE, Mass.—H. F. Watts.

SPRINGFIELD.—C. C. Webber.

MASSILLON, O.—C. A. Gates.

SOUTH BEND, Ind.—J. Durham.

PORT HURON, Mich.—W. F. Davidson.

SPRINGFIELD, Mass.—J. W. Hyde.

PAWTUCKET, R. I.—H. W. Hamblin.

AUBURN, Me.—N. J. Jordan.

FORT WAYNE, Ind.—J. A. Jenney.

CINCINNATI, O.—F. Amos Kelley.

TAUNTON, Mass.—D. L. Mitchell.

BRIDGEPORT, Conn.—J. M. Orford.

TROY, N. Y.—J. A. Powers.

SCRANTON, Pa.—Robt. Reaves.

GREAT BARRINGTON, Mass.—W. Stanley, Jr.

BROOKLINE, Mass.—C. S. Spaulding.

DANBURY, Conn.—E. T. Wightman.

MANSFIELD, Mass.—L. E. Razee.

ELGIN, Ill.—W. Hubbard.

SPRINGFIELD, Ill.—A. L. Ide.

The meeting was opened by the president, who delivered the following address:

PRESIDENT'S ADDRESS.

Gentlemen of the National Electric Light Association:

I have again to congratulate you upon the success of your organization which the large attendance to-day from all over the country evidences. Inventive ability and irrepressible energy of the most pronounced character still farther encourages us in the belief that if electrical business does not achieve a phenomenal success, it shall not be for want of intellectual activity, energy and integrity.

Great progress has been made in the last six months in electric lighting generally, but especially in the development of incandescent systems. The induction system, which permits of low tension lamps, at a great distance from the station, is a branch of lighting that has greatly increased since the last convention, and is now successfully conducted in numerous places. This system, more than any other formerly in use, is designed to find its place in the illumination of private houses. Its flexibility is very great. Its farther development is encouraging.

Lighting by storage batteries has also received a great impetus within the last three months, and while there are still some difficulties to overcome in certain branches of illumination, it is fast superseding the dangerous oil lamp on railway trains.

Dynamos have been perfected so as to give greater efficiency per pound of metal used, and our electricians are constantly working to reduce the cost of the machines, and thereby insure a large market for the same.

The perfection of the arc lamp has increased, and the demand for the same in the last six months exceeds the output of the previous eighteen months.

Mill owners and others are beginning to realize the enormous advantages of the electrical illuminant, not only in the more healthful condition of the operative, but also in the greatly decreased fire risks. The underwriters throughout the country recommend the introduction of incandescent lights to their patrons in all factories where inflammatory fabrics are made.

Abroad, the introduction of electrical installations has been slow and unsatisfactory, but of late our brethren across the ocean have taken up the subject with vigor, and to-day are becoming formidable rivals in the enterprising spirit of this country in the adoption of electric energy for all uses.

The patent office question, perplexing and unsatisfactory as we are well aware it is, is now receiving attention through the agitation of the subject by the association, and we intend to keep this matter before the world until legislation shall be compelled to furnish what is needful.

As suggestive of the multiplicity of uses to which electricity may be put, Lieut. Murdock submits a paper setting forth and explaining the electrical requirements for the new Government cruisers; and although this especial electrical application would necessarily be limited it would no doubt be useful, and still farther evidences the desire and demand for the applications of electrical devices in every branch of industry.

The perplexing wire gauge matter will again be placed before you, and if the work of the past six months of the committee on this subject corresponds with the exhaustive and excellent report made at the last convention, we may expect something definite enough this time to decide the attitude of this association in relation thereto.

I regret to have to announce the absence of the report of the committee on insulation of wire and the proper installation and construction of plant. This committee requested the association to provide the necessary means to enable them to carry out their investigation. But, as the association was in no condition to render them the pecuniary aid they required, they determined not to pursue their work any farther. I believe this to be a loss to the association; as from the statements they have made or what they intended to do, if they only had the means, I can easily forsee the loss of a great deal of valuable information to ourselves and to the world at large.

I have now the honor of introducing to this association one of the most popular mayors that the city of Boston has ever had, a gentleman who represents public interests more than the interests of any particular party or clique, and who under the most trying circumstances has shown his fidelity as a public representative to such an extent as shall make his official administration one of the most memorable landmarks in the history of Boston's progress.

Gentlemen, I now have the pleasure of introducing Mayor O'Brien.

Mayor O'Brien, who upon rising was loudly applauded, said:

Mr. President, and Gentlemen of the National Electric Light Association:

Mr. President, you almost overcame me by your very flattering remarks, but it gives the Mayor of Boston great pleasure to welcome to the city of Boston so many distinguished gentlemen who are engaged in a very important work. I hope your visit will be a pleasant one, and also a profitable one; and if you can show us any way whereby we can light our streets and dwellings better than the work is now done, we shall be very thankful to you, Mr. President, and to your association.

I read in the papers a few weeks ago, that immense fortunes were made in the electric lighting business. It must be a very attractive business; and I suppose that I am now addressing not only men engaged in electric lighting work, but millionaires (applause and laughter) of various degrees. Our experience in Boston does not, I am sorry to say, corroborate that report. Electric lighting, so far, has been introduced by the energy, the ability, and intelligence of men who have been engaged in local lighting. I believe that it is their intelligence that has scattered it over the country in such large proportions, in every city and many of the towns of the country. So far, I believe, profits have not been very equally divided. Some few men, I have no doubt, in the electric lighting business have grown rich; but I am satisfied that every man who has started a local company, either in this city or any other city, should be regarded as a public benefactor rather than as one that has derived great pecuniary benefit from his work (applause).

I do not intend, gentlemen, to advise you, or to say anything about the work that you are engaged in. I have no doubt that your discussions will be interesting, and I hope that your visit to Boston will be a pleasant and agreeable one. I know that it must be very satisfactory to many of you, coming from cities and towns where the thermometer ranges up to the hundreds, to visit so delightful a city as we have here in Boston, where you can enjoy good fresh air at about sixty-five; and if you have time, it will give me much pleasure to take you down the harbor and show you our beautiful harbor; to take you into our suburbs and show you our beautiful suburbs; and I hope that you will not leave Boston before you visit each of those places.

The electric motor, if you can can give us any advice on that, we should be very much obliged to you. We have street lines running in all directions, and we would like to run them by electric motors; but the experience of electric light men in these parts shows that experiments are very expensive. We hope that some of you who are running electric railroad motors in other cities will give us some intelligent advice on that subject. We also believe in the motor business here. Boston has neglected small industries, and I believe that if you establish a motor that will do the work, you will enable us to build up a great many small industries that have been neglected in the city of Boston. I will not detain you any longer, gentlemen, but I again hope that your visit to Boston will be a pleasant and agreeable one. (Loud applause.)

SECRETARY'S REPORT.

The secretary then read his report, which, on motion, was referred to the Executive Committee for verification. He read also the treasurer's report, showing a balance of $842 in the funds. The secretary's report included a list of the members.

THE REPORT OF THE LEGAL COMMITTEE,

was then introduced by Mr. Arthur Steuart, chairman, with the following remarks: I have the honor to make the report of the Legal Committee, as well as the report of the committee appointed at the February meeting in Philadelphia—a special committee on patent legislation. At that meeting I had the honor to read a paper upon the necessary reforms in the patent system, particularly with reference to those reforms that were needed in the Patent Office, and I pointed out at that time numerous changes that were thought necessary in the Patent Office. Principal among them was the establishment in the Patent Office of a court that would embody in itself the jurisdiction that is now divided up among half a dozen different officers all of whom are acting to a greater or less extent at cross purposes with one another. The second subject which was considered was that of the increased calibre of the personnel of the office, and some systems were suggested. The third was the increase of space in the Patent Office and the establishment of a laboratory for the conduct of experiments, principally electrical, which are very much needed, and we had the pleasure of having a few words from Mr. Kintner, who was at that time the examiner in chief of the electrical division, since resigned, in which he set before you very clearly the very great need of the office in that particular, there being absolutely no laboratory, or any apparatus of any consequence. He said that not over five hundred dollars' worth, in all, was the value of the apparatus to test the inventions which are constantly increasing, and which require to be tested in order to be understood.

Mr. Steuart then read the

REPORT OF LEGAL COMMITTEE ON U. S. PATENTS.

At the February meeting of this Association, your Legal Committee made a report in which were set out some of the present needs of the United States Patent Office; and suggested a means by which the needs might be met and the defects remedied.

The subject being one of great importance, a special Committee upon Patent Legislation was appointed, consisting of Mr. J. F. Morrison, Baltimore; Mr. Walter C. Kerr, New York; Mr. Frank Ridlon, Boston; Mr. F. J. Sprague, New York, and Mr. Arthur Steuart, Baltimore, the chairman of the Legal Committee, to further consider the questions presented, and make a full report to this convention. Your Committee has given the matter careful consideration and report that they are convinced that that branch of the patent system which relates to the granting of patents is based upon a law which was

formulated at a time when the mass of business to which it was applicable was one-fiftieth part of what it is at present and that the law needs revision in the following particulars among others:

I.

The statute law of the United States relative to the granting of patents has very few provisions which determine the rights of the applicants. The result is that nearly all the vital questions both of law and fact by which the rights of applicants for patents are to be determined now lie within the jurisdiction of the various branches of the Patent Office. The Examiners have nearly all questions of fact to determine primarily as well as many questions of law, and their jurisdiction is divided up among a number of Junior Examiners who are overburdened with work. The Examiner of Interferences sits as a court to determine the question of priority between contestants for patent on the same invention. From the Primary Examiners cases go on appeal to a Board of Examiners in Chief and from there to the Commissioner, and appeals from Examiner of Interferences go to the Commissioner. The personnel of the office is constantly changing, the Commissioners more often than others. Then, too, the persons who are appointed to the position of Commissioner are generally chosen for some reason that has no connection with patent law, so that as a general rule the highest appellate tribunal knows less about the law and practice of the Patent Office and the rules by which patent cases are to be decided than the Examiner from whom the first appeal is taken. This being true, it is not surprising that the Examiners pay comparatively little respect to the decisions of the Commissioner, and also that one green Commissioner following another in quick sucession should make rulings which result in a hopeless chaos in the practice. In addition to this fact the Commissioner is burdened with executive duties which demand so much of his time, that with the greatest experience and power of work it is impossible for him to properly consider the numerous important cases presented for his decision.

In order that the legal rights of the patentees may be fully defined and secured, it is necessary that those rights should be understood and a settled method of obtaining them established; for this reason it is desirable that some means should be adopted to make clear and uniform the practice of the Patent Office.

All authorities seem to agree that the best method of accomplishing this result is to establish a strong court in the Patent Office that shall have jurisdiction of all legal questions arising in relation to the issuance of patents as well as all questions of fact which arise in interference proceedings, and on appeal from the examiners.

II.

The work required of the Examiners in the Patent Office is of such a technical nature and so important to the public that it seems to be desirable that the Patent Office should be put on the same footing as the Army and Navy. That the Examiners should be educated for the service, should receive compensation equal in corresponding positions to officers of the Army and Navy, should have the same system of admission and promotion upon examination, and retirement on pay equal to that of those departments of the public service.

III.

The Patent Office is now cramped for space, the employés are crowded into quarters half large enough for them, and the Patent Office building, built with money paid the Government by patentees, is more than half occupied by the Interior Department, which should have separate accommodations. Additional space would enable the Patent Office to have a laboratory, so much needed, for the demonstration of electrical and other scientific discoveries and inventions.

To accomplish these reforms, the most cautious, expeditious, and at the same time intelligent way, seems to be the creation of a Commission to be appointed by the President which shall carefully examine these and all other questions relative to the subject and report an Act to Congress which will provide for their solution. We suggest the following bill which we propose shall be submitted to Congress this winter for passage:

A BILL

CREATING A COMMISSION TO EXAMINE AND REPORT TO CONGRESS NEEDFUL REFORMS IN THE PATENT LAW.

Whereas, The Patent Laws of the United States are deemed to be in such a condition as to require revision; therefore,

Be it enacted, By the Senate and House of Representatives of the United States, in Congress assembled:

SECTION 1. That a Commission be, and the same is hereby created, to consist of three suitable persons to be appointed by the President of the United States, who shall hold office until a final report of this Commission is submitted to and accepted by Congress, and who shall receive for their service a compensation of $5,000 each per annum.

SEC. 2. It shall be the duty of this Commission to examine thoroughly the patent laws of the United States, and those of other countries, and their practical operation and effect, in meeting the needs of the public and fulfilling the purposes for which they were created; to formulate a report to be submitted to Congress which shall set forth the results of this investigation and their conclusions therefrom, with reference to changes in, or additions to, the present law, pertaining to patents. The report shall also contain a draft of an act which will provide for the changes found necessary by the investigations of the Commission.

SEC. 3. The Commission is authorized to employ such clerical force as may be necessary for the proper conduct of its work and to incur such other expenses for stationery, printing, etc., as may be found expedient.

SEC. 4. The salaries of the members of this Commission as well as all expenses legitimately incident to its work, shall be paid from the surplus in the United States Treasury to the credit of the Patent Office. All expenditures by or for said Commission, other than the salaries of the members, shall, however, be under the control of and authorized by the Secretary of the Interior.

And now a duty devolves upon the members of the Association. It is one thing for your Committee to make this report, but a totally different thing to have it passed by Congress. That result can, however, be accomplished if the members of the Association will intelligently and faithfully support the hands of their Committee, by themselves, each one of them, doing the part of the work assigned him to do. This Association represents twenty-four States, and members of this Association are fellow townsmen with eighty members of the House and Senate, while the members of the House and Senate from the States represented in the Association are sixty-one per cent. of all the members of Congress. The Committee have divided up the members of Congress among you, and assigned to each the duty of seeing the members of Congress from his State, and urging upon them the importance of the passage of this bill. Its passage lies in your hands.

The Committee think it very desirable that the next meeting of the Association be held in the city of Washington. The location is central and Congress will be in session at that time. The members of Congress will have an opportunity of seeing how large and important an interest is calling upon them for action, and the members of the Association can take the opportunity of waiting upon their Representatives in Congress and urging the passage of the bill we present for the appointment of the Commission.

Present at the meeting of Committee, July 21, 1887, New York:

J. F. MORRISON,
FRANK RIDLON,
WALTER C. KERR,
F. J. SPRAGUE,
ARTHUR STEUART, Chairman,

REPORT OF LEGAL BUREAU.

Mr. Steuart then added:

I have only one other word to say, and, that is to submit the written report to the Legal Bureau. I shall not read it. It simply gives a statement of work being done by the Legal Bureau, of which I have the honor to be the custodian in reference to a digest of the literature of electric lighting. We have at our command at present a set of journals and books which I suppose are not to be found anywhere in this country save in Baltimore, and we are now preparing an analytical digest of the literature of the subject which we feel sure will be useful to the association.

The Custodian of the Legal Bureau would report that in the near future he expects to be able to offer to the members the use of an analytical digest of patents, as well as the literature of electric lighting and subjects collateral to it, that will make it possible to determine with great accuracy as well as expedition the exact state of the art in any department, and hence the validity and scope (as far as such can be determined in the absence of judicial determination) of any patent that may be submitted for examination. The digest will embrace all United States patents on electric lighting and collateral subjects.

English patents.

French patents as far as they can be obtained.

And the following publications. (Here followed a list of thirty-three publications, scientific and technical, in several languages.)

In addition to the foregoing, such books will be added as are found of value.

Mr. RIDLON: I wish to offer the following resolution in regard to this report:

Resolved, That the report of the Committee on Patent Legislation be accepted and the committee continued, and be authorized to take such steps, not involving expense to the association, that they may find necessary to have this bill as presented passed by Congress. Adopted.

The PRESIDENT: The report of the Committee on Revision of the Constitution will be presented by Mr. DeCamp.

Mr. DECAMP: In looking over the reports of the various meetings, it appears that there have been several amendments made to the constitution which we have printed that change it entirely. Therefore we have thought fit to submit an entirely new constitution as a substitute for that which was originally adopted, and I now lay it before you.

The secretary then read the

REPORT OF THE COMMITTEE ON REVISION OF THE CONSTITUTION.

Dr. A. W. Garratt moved an amendment to the by-laws as presented, permitting the entrance of four persons to the association instead of three, from one firm. Carried. After some further discussion on the propriety of making the office of secretary and treasurer one of appointment with the president, the report was recommitted, with instructions to the committee to report at a later session. Mr. Duncan was added to the committee.

The President then called for the

REPORT OF THE COMMITTEE ON WIRE GAUGE,

of which Mr. A. V. Garratt is chairman.

Mr. GARRATT: A year ago in Detroit a committee was appointed to consider the matter of wire gauge, which at that time was in an almost hopeless condition. After six months of constant correspondence with the largest users and makers of wire in this country and abroad, and the leading scientists in the specialty of electricity, I reported at Philadelphia that this association do two things: First, that it vote that the British standard gauge be no longer the recognized gauge of this association, and secondly, that the metric system be made the basis of measuring wire. Both of these motions—or they were incorporated in one motion, one report—were accepted. The honor conferred upon me in accepting my report was not less than the honor I received in being again placed at the head of the committee to elaborate this subject. The committee was considerably increased by the addition of some valuable members. During the six months we have taken the subject of measuring wire in simple diameter in the tenth of a millimetre, and have elaborated it into a mathematical table. This table is not of necessity a gauge, although the first column to the left represents a series of even numbers—integral numbers, which agree with the tenths of millimetres which appear in the next column or column No. 2. The object of doing that is this: In sending telegraphic messages I find it is almost impossible to make a telegraph operator use a decimal point. It is almost impossible, also, in hasty writing to get the decimal point in the right place. For common purposes, in speaking of wires in ordinary business parlance, a simple number is more convenient than a number with a decimal point; for this reason a column of figures is here placed with simply that decimal point removed. That, however, is not the gauge, if there is any gauge. The gauge, if there be one, is the simple measuring of wires in diameter in tenths of a millimetre that appears in column 2. As we have in this country a unit which is much more familiar, the inch, it seemed wise to this committee to convert those diameters into inches for the purpose of referring to tables which are already constructed, and with which many electricians are thoroughly familiar. For that reason, table No. 2 was multiplied by a constant which represents tenths of millimetres in the denomination of inches. It was multiplied simply by the number .039379. That converts the tenths of millimetres into inches, so that though unfamiliar with the metrical properties of wires, you can readily refer to those tables and see just where they are. An electrician looks upon a wire not as a wire, as we ordinarily express it, but as a cylinder, and the properties of wires are based upon the properties of cylinders. There are three properties of wires which enter into the work which we have to do, viz., The tensile strength of the wire; that I shall not touch upon; it is a subject by itself and does not directly interest us. Next, the static capacity of wires; that also I shall not touch upon, because in electric lighting wires it is entirely a negligible quantity in the present state of the art. The third property is the conductivity, and it is necessary for us to know the ratios of conductivity of the weight to size in diameter and to length of conductor. The first thing we want to know about a cylinder to determine its physical properties, is its sectional area. In this particular table, to insure almost absolute accuracy, the mathematical work was done independently by two members of the committee: Mr. P. Keilholtz, of Baltimore, independently calculated tables 4 and 5, which you see here. Mr. Herbert H. Eustis calculated the same tables. They were both submitted to me; I compared them and found some differences. Where differences occurred I independently made two calculations upon different days, and if those two calculations agreed I submitted them to the other gentlemen and the alteration was made in their calculation. Virtually, then, these columns 4 and 5 have been independently calculated by three persons. The likelihood of error has been reduced to a minimum by not calculating it by ordinary arithmetic, but by calculating it in logarithms, and the logarithm was used that is used in fine astronomical calculations, viz., the seven place logarithms compiled by Vega. I will say that carries the accuracy so far that even in calculations as to the solar system very slight errors are found. In that calculation comes in the property of the π-ratio. This section area was calculated by these two gentlemen from different formulæ. Mr. Eustis calculated it from the square of the radius of the cylinder multiplied by this ratio. Mr. Keilholtz calculated it by this formula, $\pi\frac{d^2}{4}$, two entirely independent calculations. Probably the tables here of area in square millimetres and square inches is about as correct as it is possible to make a table of figures. The calculation into the square inch, of course, was an independent calculation bringing in the ratio which we already have between the inch and the square millimetre.

Before I go on to the other details I will say here why we put this question of sectional area so conspicuously on this table and so near the beginning. The properties of conductivity of wire are directly proportional to the sectional area.

These tables of area are based upon the π-ratio. The conductivities of wire are proportional to the sectional area. They are, however, proportional to another property of cylinders which are entirely independent of the π-ratio, and which is extremely simple in practical use. The conductivities of wires are directly proportional to the squares of their diameters. You will find, in column No. 16, squares of diameters. Wires have to be used by a great many men who are too hurried in life to familiarize themselves with mathematics and with electrical formulæ and who want to get quickly at what wires may be expected to do. From this simple table, No. 16, by simple arithmetic you can arrive at almost any physical or electrical property of the cylinder, or of the wire, which is a cylinder. For instance, if I have a small wire, or if I have twenty small wires, and I wanted to have a large wire of the same conductivity, I would simply have to take that square of diameter multiplied by thirty, and look in the table and find the nearest corresponding numbers in this column, No. 16, and I would have the wire which would give the same conductivity. In problems involved in the work which linemen are obliged to do who do not care to go into those matters at all, they have in such a table necessary data for determining nearly everything which they would be required to know.

The units were taken from Matthiesen's last determination—the British Association unit—multiplied by the constant which converts that resistance into the legal ohm. This gives the resistance and also the physical properties based on the resistance, such as feet per ohm and pound per ohm, corresponding to the legal ohm.

Many gentlemen will take exception to the fact that this is calculated at zero centigrade. This convention if it sends out this circular, has got to commit itself before the scientific world as having done a thing which no trade body in the United States has heretofore done. It is a scientific matter. It will be studied. These calculations will be gone over by scientists and mathematicians. Zero centigrade is now recognized the world over as the unit of temperature. There is no probability in the immediate future of its being changed at all. I have corresponded with leading professional electricians in this country, and without a single exception they replied to me—by all means determine your gauge on zero. Every electrician is familiar with the simple con-

stant, which is 0.21; by multiplying the zero Centigrade, which is 32 degrees Fahrenheit, by the number of degrees which it will differ from what we want; if you want to convert to 75 degrees Fahrenheit, and multiply it by the constant, you will get the resistance of it at 75 degrees Fahrenheit, and you can do it at any other temperature at which you see fit. But the zero Centigrade is that on which all scientific work is based when the question of temperature is involved.

As regards the question of making these determinations of resistance, etc., on commercial copper or on pure copper, the committee found it utterly impossible to determine what commercial copper was; hence, this table has been calculated upon the basis of chemically pure copper. If any manufacturer adopt and use this it will be very easy for him to append a constant at the bottom of his table, which you can multiply into any one of these properties and convert your weight, your resistance, etc., directly into the degree of purity which they claim to put out commercially. In our association we have got to have a thing which can be used as a standard all over the country, and for that reason chemically pure copper was taken.

There are two other tables here which may not be of much interest, but which this committee has seen fit to tabulate to enable electricians, generally, to make calculations of this gauge in fine electrical work; that is, a table of logarithms of area. We have appended seven place logarithms which have been calculated by three members of the committee—a logarithm of the square millimetre and a logarithm of the square inch of independent size of wire. That, of course, is not a commercial figure; I don't know that it will ever appear in a trade statement; but it is valuable for us to use and put out.

Last of all, and to get our minds familiar with an unfamiliar thing—and here I must say that of course it will be impossible to take up any new thing, no matter what its value may be, without putting ourselves to considerable worry—no man here could take up this metric gauge and work at it on five minutes' notice. He would not, however, work at it five minutes without discovering that he was using much fewer figures than would otherwise be necessary.

Tables 17 and 18 are the nearest numbers corresponding with the Birmingham and Brown & Sharpe gauge. The Brown & Sharpe gauge I have taken from a manuscript copy sent to a member of this committee by Messrs. Brown & Sharpe, and I will say here that of the wire drawers who publish Brown & Sharpe tables, very few of them agree as to the actual size of Brown & Sharpe numbers. I examined the table, in which out of forty numbers of Brown & Sharpe, twenty-eight were wrong, and that was from one of the best wire makers in this country; that is, they did not agree with Brown & Sharpe's own statement in regard to their particular gauge.

In regard to the Birmingham gauge, I will say there are fourteen independent Birmingham gauges in use at the present time. I have taken Mr. Gordon's figures in regard to the size of the Birmingham gauge for the purpose of comparing it with the metric. Mr. Gordon has spent a great deal of time upon the question of the physical and electrical qualities of wires. Among other things, he has compiled the largest tables on the properties of wires which has ever been compiled, expressed in the old ohm. I have taken his sizes of Birmingham to compare with the gauge.

I will not further bother you with these figures. Of course this committee has been very glad to do this work. All of the work other than the first five columns has been calculated by Mr. Eustis and myself. It has occupied every evening for three or four weeks until past midnight most of the time. We have put our best work and energy into this. We have based it from the best information that we could get inside and outside of this association, and we have not failed to consult with any one from whom we could get assistance. We have corresponded with the Smithsonian Institution at Washington, and although they were unable, for want of apparatus, to give us any direct aid, they gave us their most hearty assurance that the deliberations of this assembly should receive proper recognition before the government of the United States, and if in their opinion it was wise, it would be adopted as the government measure of wire of the United States. I will say here that by act of Congress the metric system is already the legal system of measuring of the United States government. It is used in many of the departments. Every scientist works in it and every chemist, and it is simply a question of time, no matter whether we adopt this particular gauge or whether we discard it as useless—it is simply a question of time when the properties of everything that can be measured will be determined in the metric system. We have this now in this form. It is useless for any body of men to attempt to legislate what other men shall do. It is useless for a body of men to attempt to legislate what they shall themselves do. If this association should vote to adopt and use any other gauge than the metric gauge they never would be able to enforce it among their members unless those members found it for their advantage so to do. Personally I do not anticipate that everybody is going to lay aside thousandths of an inch, the Brown & Sharpe gauge and the Birmingham gauge and immediately take this up. I know, however, it is only a question of time when some such system of measuring will be used that will do away with all arbitrary numbers which in themselves convey no idea as to the quantity which you are expressing.

The question of bringing this commercially before this country is a grave one, and one to which I have not given the attention that I have given to the mathematical properties of the gauge. Of course, I have corresponded with all of the wire makers in regard to it, and at the last convention I read a voluminous correspondence from them, the majority approving of this and hoping that it would be carried out.

I propose this afternoon to have this table electrotyped. It will then be the property of the association in electrotype. It can then be cut up and such portions of it furnished to manufacturers as is thought fit. This gauge goes from the tenth of the millimetre to ten millimetres, which means from about a No. 38 wire to a No. 00 or No. 000 wire; in some portions of the gauge, it gives a much finer division than either of the others; in other portions it does not give near as fine. In the gauge which would be used in incandescent wiring, it gives much finer properties; for example, in No. 12 there are five wires in this gauge instead of the dimension of No. 12 wire and electricians are getting to work finer and finer on the properties of their wires all the time. It is a tendency of the time to do so. As you go up into the larger wires it becomes very marked. In the larger portions of this gauge there are 7, 8 or 9 numbers instead of the single number of Brown & Sharpe or the Birmingham gauge. I received a number of letters from well meaning persons calling attention to the fact that in a small portion of this gauge there is too great a variation between the numbers. That is very true; but nobody can tell just what size of wire anybody wants in these small sizes. To tabulate it would be to make a book as big as the dictionary almost; but from the figures given any electrician can calculate the electrical and physical properties of any wire varying in hundredths of a millimetre. All of the data necessary for making such computations is here. I presume in those fine wires, if this system is adopted, you will find in the course of a short time that manufacturers will be publishing odd numbers; instead of No. 2 gauge it might be 2.25 which might meet the particular requirements of somebody. Those first ten numbers will probably undergo considerable alteration. This will be the basis for determining those physical and electrical properties. Take it in the use of expensive wires, in platinum, for example, no man drawing expensive wires can afford to adhere to any particular gauge, because the requirements are so nice in regard to it; but from these data you have here there is no difficulty in any one determining just what the resistance will be or the size shall be or the weight of any wire he wants, determined in terms of a hundredth of a millimetre, which is about three times as small a difference as you will find in the thousandths of an inch.

Mr. C. O. MAILLOUX: A few friends of mine I see beginning to smile as I get up to say something on the wire-gauge question and probably what makes them smile is the remarkable slowness with which we have been arriving at any sort of conclusion relative to any wire gauge. The Committee of the American Institute of Electrical Engineers has had the subject of wire gauge under consideration for a long time—it must be two or three years. There has been more or less interest taken in it by the members of the committee and efforts to arrive at the determination on what is proper and right in wire gauge. I was very much interested, as being a member of that committee, in the report made by Mr. Garratt, and I think that we should appreciate the care, the precision and the assiduity with which that committee has carried on its work. But at the same time I feel that I must emphasize a point which he himself has alluded to. I am brought to this consideration by remembering that while a gauge may be particularly suited to the requirements of one individual or set of individuals, yet it is of the utmost importance that a gauge, in order to become universal, should have the elements of usefulness to all parties who are using gauges. I notice that between the size corresponding to No. 38 of Brown & Sharpe gauge and No. 32 he has only one number; there is only a difference of a tenth of a millimetre. Now those who are in the telegraph business and the telephone business and many other cognate industries would see at once a very grave objection. It is true, as Mr. Garratt proposes, that we may have several sizes—smaller sizes in tenths of a tenth of a millimetre; but if we begin to introduce the subdivision of the scale it seems to me that we might just as well have no scale at all, and revert to the principle of determining the diameter by the thickness in the first place, irrespective of any number or of any gauge for that matter. As you all know it is a common practice in this country, and there seems to be a large preponderance of sentiment in favor of determining the size of wire by thousandths of an inch. The difference in the use of systems of measurement is one which has full weight, of course. At the same time we must not forget that in this country we are, so to speak, married to the old system of gauge, and that there is only a very small proportion of the people who really understand the system or could use it intelligently; and therefore it looks to me that, while the system is very well adapted indeed to the requirements of the electric light industry, insomuch as it affords a long range of sizes differing from each other by very much smaller differences than the gauge at present in use, yet, as we get to the other end of the scale it is just so far deficient as it was advantageous at the former end. If wire makers throughout the country were to adopt the system of gauge and draw their wire in accordance therewith then if a telegrapher or telephonist wanted to rewind a magnet that was 38, and wanted the next size larger, he would have to use what would correspond to No. 32, and I find that the resistance per given length varies in the ratio of four; whereas, by the present system we have a ratio which varies by less than only a little over 90 per cent.

After due consideration of all these points, the committee of the American Institute of Electrical Engineers, comprising in its body a celebrated engineer, a man who is connected with the United States Army in the Engineering Corps, a very skillful mathematician, has come to the conclusion that no system of gauge in which the sizes are defined by equal increments of diameter can ever hope to meet the requirements of the general body of the electrical industry; and if we look into the matter closely we shall find that the gauges at present in use have after all a great deal of convenience, and that the gauge which would be based on the same principle would at least be entitled to some consideration before we vote to adopt definitely or inflict upon the community one more of the numerous wire gauges. I say inflict, not because I wish to disparage the very fine work that has been done by our committee, but because to add another official gauge to the number already existing would be to increase the perplexity with which we are now so greatly troubled in trying to make calculations regarding wire.

The basis, I think, of a proper gauge would be an asymptotic one, a gauge in which the sizes of wire vary with the resistance or the sectional area as a function, as a variable quantity, so that the ratio would be represented by a third, which is hyperbolical, somewhat nearly like the basis of the present Brown & Sharpe gauge. I think it would be proper to modify these gauges by introducing some intermediate sizes. In that case, as it will readily appear, it would be possible to represent all the numbers of gauges by formulæ, so that, knowing one gauge or the diameter of a gauge, an electrician or a mathematician could easily calculate all the others and derive all the properties belonging to the others; and if he were using formulæ he could introduce the formula itself and in that way arrive at the properties of all others by the usual method of elimination of quantities.

Mr. GARRATT: Will the gentleman kindly give an example in gauge calculation which an unintelligent man could make on the Brown & Sharpe gauge or the Birmingham gauge, which he could not make by measuring wire by the diameters in tenths of a millimetre. He made the statement that the metrical system was unfamiliar to the general run of people, and therefore they could not use it with the facility with which they could use the Brown & Sharpe gauge. Will he kindly give me such an example, or will he state one to the board himself.

Mr. MAILLOUX: I think I should state that you find in practice that the electricians or the men that Mr. Garratt refers to—the linemen—would not go to the trouble of multiplying, because a great many of them could not multiply two quantities of two figures each.

Mr. GARRATT: There is one other thing. The gentleman said it would be good to have the gauge on the same principle now in use. Will he be kind enough to state the principle on which present gauges are made.

Mr. MAILLOUX: The Brown & Sharpe gauge is the only one which may be said to have any principle at all in it. The others are a merely arbitrary form of gauge which has come from long usage and custom with reference to convenience, and when I speak of the objections to a gauge, I do not refer to the electrical features of the gauge only, because I believe that a gauge which can have any hope of being universal must be applicable to other requirements besides those of electricians. It is a custom in measuring sheets of metal and various other things in commerce, to measure by sizes like that, and I think that it would be doubtful if a system of that kind could be made applicable to these uses. Now the basis of the Brown & Sharpe gauge can be represented by drawing a triangle having a certain definite length and a certain base. The trouble with the Brown & Sharpe gauge is that the ratios are not uniform, but they could be made so, and I think it would be possible to construct a gauge having an asymptotic curve as a basis which would be thoroughly scientific and satisfactory I will say that I do not claim to understand the matter so fully as perhaps the gentleman himself does, as he has gone into the matter more fully than I have. Other business has called me away from the study of these things; but I am fully convinced nevertheless, that there is some consideration in favor of the other gauge, and that while this may be entirely satisfactory, and while it has great advantages on account of its metric basis, which I recognize, yet it cannot be denied that it does not answer the purposes of the other.

Mr. GARRATT: I will say, in regard to an asymptotic gauge, that I corresponded, as far as I could, with every maker and user of wire in this country and abroad, and I found just one gentleman who advocated it, and he was a distinguished mathematician in the United States Army—Captain Michaelis, of Troy. I corresponded with him on the subject, and we could not come to any very good understanding. The asymptotic curve is the property of a tangent to a parabola at an infinite distance. I did not find any other man in the United States—I have now found another—who advocates such a gauge.

Mr. MAILLOUX: I think the question bears more on what people have been doing and on what we can make them do. I have no doubt it is easy enough to make a far more scientific gauge than people could use. We have the experience of this country in the rapidity, or rather slowness, with which it has adopted the metric gauge. What I have reference to is that, as people are accustomed to gauging thickness by a certain letter, we must not give them something which is so radically different that by its very radicalness we shall make people object to it.

Dr. MOSES: I also feel as if I should say, in view of the probable adoption of the report, that the metric system is one so well known and so generally used at present that there is no necessity for us to advocate it as a standard. The government has done so already. Other governments, even the German government, opposed as they are to the French, have in a certain disguise adopted the metric system; they were forced to do it; so that we must for the present not consider the advisability of adopting the metric system, because it forces itself upon us, and if we acknowledge it we simply acknowledge the inevitable. But there is some weight in a remark made by Mr. Mailloux that I would like to call attention to, and Mr. Garratt sounded the keynote for it when he said it was impossible to consider any standard of conductivity because it was something that varied with all of the commercial products. It is a very important thing that there should be some standard always, but where you have the essential standard always varying it is very difficult to fix it. But we have in the use of the units themselves the adoption of the metric system. We are employing them constantly for all the varying moods and tenses of the current, and why may we not adapt them to the uses of the consumers of wire, since ultimately what is to be determined is the resistance of the wire? Since it is the resistance of the wire, entirely independent of the material, that has to be calculated by the electrician, it is of the utmost importance that we should be able to calculate the resistance rapidly. Now the resistance varies in any two specimens of wire. I take a wire; it measures such and such resistance; I twist it accidentally—it measures a different resistance. So we have to take something as we find it and determine what we have or what we want. Now, I do not like to speak always in a prophetic mood, but I think the day is not far distant when we shall have measures of resistance that will be as portable as a Brown & Sharpe wire gauge. I think that we will be able to take an ordinary lineman and give him this instrument, and let him say, such and such is the resistance measured on a dial, if you please, of such and such a length, measured for him, and in the nature of the instrument itself constant and independent of his erroneous observations. He takes a certain resistance of a certain unit, and if he can multiply—and he has probably been taught how to multiply, though he has not very extended mathematical knowledge—he can multiply that, and let the unit be an inch, a yard, a metre, anything you please, he simply multiplies it by the number of units that he wishes to, and he has his result accurately given. Now, I do not say that that machine is invented, but I say that it is possible to invent such a machine and to make it most exact and very portable. Now it is immaterial to me whether my wire is iron or gold, or silver, or whether it has a conductivity of *A*, *B*, *C* or *D* as long as I get the greatest amount of conductivity for the least amount of resistance reciprocally for a given weight in hard cash. That is all I want to determine.

When once that is determined, why, I give my order to Tom, Dick or Harry, and the man who gives me the most conductivity for the least money gets my order. It is quite immaterial to me whether it is No. 38 or No. 32. The little difference in the space that a wire occupies in a concealed fitting or in a pipe that brings it to a light or to a telephone does not impress me as being a matter of any very great importance. The insulation varies so much in thickness; and as nearly all wires are insulated that are at present in use, it is immaterial for us to consider very absolutely what the exact diameter is. It is something entirely outside of the financial question. The question is: What is the resistance and what is the cost? Now these things will settle themselves the instant we have a little piece of apparatus by which we can take a unit of length and determine its resistance and let that be done by the most uneducated person. I would, if it is permitted to me as a member of the committee who waives any right to the praise, extend the thanks of the convention to the laborious members of the committee who have sacrificed the midnight oil for the benefit of our association. (Applause.)

Mr. MASON: If I understand Mr. Garratt rightly, he states that this matter was decided at the annual meeting, just past, of the association—namely, that the association adopt this system.

Mr. GARRATT: Accepted it.

Mr. MASON: Then I would like to ask the chair to inform us where it leaves us now? As I understood from Mr. Garratt the committee was continued to perform certain clerical work. If that is so, it is simply for us to determine whether or not they have done their work. If I understood him correctly, we are not called upon to discuss the question of this or that gauge, but of the quality of this work and whether we will accept these tables. Will the chair please decide that? I would say that I remember reading in our electrical newspapers that the report of the committee was adopted.

The PRESIDENT (reading from the minutes of the last convention): "Mr. Powers, of Troy, made a motion that the matter should be left in the hands of the committee for a further term, and that the committee be increased to five, with instructions to report further at the next semi-annual convention, and that in the meantime the report of the committee be accepted. (The report was accepted and placed on file.) And such suggestions as they made were to be carried out in regard to printing copies, so as to enable the members of this association to familiarize themselves with the new gauge in case it should be adopted at the next meeting." Now, is the case thoroughly understood? The fact is, the matter was referred back to the committee and it has come up in the shape of a report.

Mr. MASON: The mistake arose from the misuse of the word accept. In parliamentary usage, accept is tantamount to adopt.

The PRESIDENT: No; you can accept a report and place it on a file without adopting it.

Mr. LYNCH: I would like to suggest that Mr. Garratt add to his already very excellent report a column showing the safe current carrying capacity of the wires at different temperatures. It would be a fact that for our country members it would be very acceptable to them.

Mr. GARRATT: I would simply say that it is necessary to multiply the table of areas by a simple constant. I believe that Sir William Thomson found that in the British Navy the safe limit should be one and a half ampères to the millimetre in sections. That is rather a larger allowance than we have used in this country, but you will find any quantity of references to that, and all you have to do is to take your area and multiply it by a simple constant which you can memorize.

Mr. LYNCH: Would it not be possible to have a few of those constants placed on this table?

Mr. GARRATT: If I am so instructed I will do so.

Mr. STEUART then moved the adoption of the report.

Mr. PHELPS: I would like to ask what the significance would be of adopting the report. Will the association be committed to promulgate this as a wire gauge and recommend its adoption as a wire gauge or not?

The PRESIDENT: I will answer that question. If this report be adopted, then this association pledges itself, and its members pledge themselves, or each one pledges himself individually, to carry out the law laid down by this report. You may call it whatever you please; but this committe reports a method for measuring wire which we will adopt if we adopt the report.

Mr. PHELPS: The key to what I was going to say is furnished by Mr. Garratt in his remarks a little while ago, when he said there is no gauge. It is an infinitely useful compilation. A useful system is here provided for ordering wires by diameter, and a great step, in my judgment, is taken and gained in using metric diameters instead of inch diameters. But I should hesitate myself to assist in promulgating a wire gauge. I think if we were to turn the matter well over, in view of Mr. Garratt's remark, there is no gauge, unless you choose to call it so, but an almost infinitely useful aid to the manufacturer and orderer of wire, and if the association can promulgate this information in a way to make it useful to everybody having to make, buy or use wire, and by so doing put a peg in toward the further use of the metric system, that, it seems to me, will be a useful thing to do; but do not let us call it a new wire gauge. We have got more wire gauges than we want. You see my idea, Mr. President. I would like to hear from Mr. Garratt.

Mr. GARRATT: There is no wire gauge about it. If I understand the matter right, the electric arc light men will use a definite number of wire, perhaps; the incandescent men will use a certain other definite number; the men who make hairpins will use another number. They will have those sizes, and it does not make any difference whether you express them in tenths of a millimetre, in thousandths of an inch or any other measure you see fit. All that I advocate is, that we express the size of the wire we use in the metric system, and not by an arbitrary number which means nothing.

Mr. PHELPS: It is very gratifying to know that the practice of ordering wire by diameter has been constantly growing of late years. It has been found a sort of a necessity by people who require wire of any accuracy. Part of the work has already been done. We are accustomed to ordering by diameter, but mostly use thousandths of an inch. This information will enable people to use a better unit of diameter and that is the main function of it, and the information supplied here of the physical properties of wires based upon their diameters is something we have not had before, and as I said before should prove infinitely useful.

MR. GARRATT: If you introduce this asymptotic curve you are introducing the question of high mathematics again; you are plunging us again into a new gauge; you are plunging us into something that is purely arbitrary. It will be a laborious thing for thousands of people in the United States. We measure ground by feet and rods; we measure length by thousand feet. Why not express our wires in diameters and by the metric system?

Mr. MASON then moved that the matter be laid on the table and be the special order for the opening of Thursday's session.

The motion was carried.

In the absence of Mr. Slattery, who was to have read a paper on Electrical Distribution by means of Alternating Currents, the partial report made by the Committee on Insulation and Construction of Plants was taken up. Previous to its reading, Mr. Robertson, one of the committee, resigned, giving as his reason that he had not signed the report, because he did not agree with its contents.

The PRESIDENT: Before placing the next paper in the hands of the secretary to be read, I beg to say that on a date, which I am unable to find in the correspondence, this committee—either all six or one of its members, perhaps more—wrote to me asking that the National Electric Light Association furnish them with a fund of $1,000 to carry on their investigations, guaranteeing the cost of repair to any apparatus that might be damaged in the course of their investigations—apparatus which was to be supplied to them from the University of Pennsylvania; also that an assistant be furnished at $3 a day. I laid that correspondence before the executive committee which met in Boston on June 9th. The committee found only one course open to them. The funds of this association are applied to its running expenses, with which you are all familiar. There was no such sum on hand to be turned over to the committee. Nothing more was heard from the committee until this paper, with quite a column of printed matter, was sent in yesterday or the day before to the National Electric Light Association. Now this paper is signed by Edwin J. Houston, chairman, William D. Marks, Carl Hering and M. M. Garver and is not signed by Mr. Robertson, and the reason he gave for his resignation, independent of this paper, was that he could not subscribe to the subject matter contained in this report.

The report was then read:

REPORT OF THE COMMITTEE "ON PROPER INSULATION OF WIRES AND PROPER INSTALLATION AND CONSTRUCTION OF PLANTS."

The committee appointed by your honorable body hereby respectfully submit the following report:

The rapid growth of the electric lighting interests during the last decade, the large investments already made in such interests, together with the still greater growth that is probable in the near future, have strongly impressed your committee with the important nature of the work intrusted to them.

Your committee fully recognized the fact that any report to an association that represents the leading electric interests of the country, would naturally be expected to be of a thorough character; they therefore determined as far as lay in their power to spare no labor in the performance of their work.

The duties charged on the committee naturally divide themselves into two general classes, viz:

FIRST. The proper insulation of the wires or leading conductors.

SECOND. The proper installation and construction of the plant as far as relates to the insulation and protection of the machines, lamps, conductors and accessories, and to the saf ty of consumers, attendants and buildings.

The first branch necessitates an exhaustive and carefully planned series of practical tests as to the insulation of the leading wires; the second, the preparation of a Code of Rules, based on actual experience for the general installation of the plants, both so far as concerns the insulation thereof, and for its protection, as well as that of the consumers, attendants and buildings; or, in other words, to provide for such an installation of the plant as will best insure the protection of life and property.

Referring to the first branch of its work, your Committee appreciate the fact that a mere theoretical discussion of the subject would prove of but little value to an Association composed of men practically engaged in electric lighting.

They are aware that considerable valuable data have already been accumulated concerning the high insulation required for telegraphic cables, especially submarine. They are also aware that laboratory tests have been made of ordinary electric wires. These data, however, either refer to conductors not included in the scope of your Committee's investigations, or, though referring to electric light conductors, have been made under conditions that would render them of but little practical value in this connection.

Your Committee therefore planned to make a careful series of practical tests under conditions as nearly as possible similar to those to which the conductors are actually subjected in existing installations.

The Committee determined to limit the investigations chiefly to the leads that are ordinarily used in arc and incandescent lighting, subjecting them during such tests, as nearly as possible to the various disturbing or other conditions that are met with in actual practice. They hoped by these means not only to obtain data by which the relative commercial efficiency of the different wires in the market could be determined, but also possibly to lead to the determination of the best conditions to be observed in the manufacture of insulated wire, in order to insure the production of the most serviceable material.

Tests, such as those contemplated, and of necessity required by the character of the work, not only called for excessive labors on the part of the Committee, but also for the use of specially designed apparatus. Although the Committee had the use of the well equipped electrical laboratory of the University of Pennsylvania, kindly placed at their disposal by Prof. Marks, one of the Committee, and the use of valuable apparatus belonging to other members of the Committee, additional apparatus was required, which, if specially designed, must be purchased, or if of existing types, must be borrowed. Then, too, the services of an assistant were required to start and look after the fire for the steam engine, clean out the boiler, run circuits, and do such other work as the Committee could not be expected to do.

In order to obtain for these tests currents similar to those used in actual practice, various dynamo-electric machines would necessarily have to be borrowed. In view of these facts, the Committee deemed it but fair to request the Association to guarantee a sum sufficient to meet actual expenditures, and further to assume responsibilities for apparatus loaned to the Committee, feeling sure that the Association could hardly expect the Committee to assume such expense in carrying out work of the character intrusted to them. This request, the Committee were informed by your representatives, could not be entertained. The Committee are therefore forced to resign.

Desiring, however, to give to the Association such incomplete parts of their work as represented the results of their labors up to this time, they beg leave to submit the following incomplete Report:

1st. On the preliminary code proposed for the tests on insulation of the conductors, etc.

2d. On an incomplete draught of a preparatory code of rules and regulations for the installation of an electric plant intended to serve as a basis of experiment by the committee, and to be sent in printed form to the various electric companies and insurance interests for comment and criticism, before finally being submitted to the Association.

As regards the preliminary code of tests, however, your committee wish it to be distinctly understood that they recognize the fact that preliminary tests on such code would, in all probabilty, show the code to be impracticable in certain portions, or at least to need modifications or additions.

In the preparation of the following preliminary Code the Committee bore in mind that leads possessing the requisite durability and efficiency for electric work, should possess as far as possible, the following requisites, viz.:

1st. High insulation.
2d. Impermeability to moisture.
3d. Incombustibility.

In this view we submit the following preliminary Code for tests, subject to the changes, modifications or extensions already referred to.

PRELIMINARY CODE.

(1). *Leakage Tests.* (*Arc Wires.*)

A definite length of insulated arc light wire to be immersed all but the ends in water. The water is connected to one pole and the copper to the other pole of a machine giving 3,000 volts, which is assumed to be the highest electro-motive force ever used in practice. The leakage from the copper through the insulation to be continuously measured by a suitable ampère meter, the measurements beginning immediately on the immersion of the wires, and the tests to be stopped when the leakage reaches a certain definite amount. The greater or less rapidity of increase of leakage may then be assumed to indicate the less or greater value of the insulation.

(*Incandescent Wires.*)

Incandescent wires will be subjected to similar tests, differing only in the voltage to which the insulation is to be subjected which will be in the neighborhood of from 100 to 150 volts, since, as it is known, at a voltage of say 60 volts moisture does not seriously interfere with ordinary underwriters' wire, while a somewhat higher voltage will set fire to wood through underwriters' insulation.

(2). *Absorption Tests.*

Coils of wire of definite length are immersed in water and their ability to resist penetration or absorption thereof will be measured by the increase in weight after equal duration of immersion.

(3). *Frost Tests.*

The ability of the insulation to resist the disintegrating effects of frost, on the alternate freezing and melting of the absorbed moisture, will be tested by the similar effects produced by the alternate absorption and crystallization of a solution of some chemically inert salt, such as magnesium sulphate. After the wires have been subjected to the frost tests (3), the leakage tests (1), and the absorption tests (2) will be repeated.

(4). *Flexibility of Insulation.*

A definite length of wire will be wound around a small cylindrical rod, say one inch in diameter, after which the leakage and absorption tests (1) and (2) will again be repeated.

(5). *Abrasion Tests.*

A definite length of wire will be bent in the form of an inverted U, having a given radius of curvature, and will be hung over a wheel, such for instance as a gear wheel having polished teeth with rounded edges, and heavy weights will be attached to the two ends of the wire. The wheel will then be turned and the number of turns noted before electrical contact is made between the copper of the wire and the metal wheel.

(6). *Adhesion of the Insulation.*

A definite length of wire is bared of its insulation at one extremity, and the bared end passed through a closely-fitting hole in a die plate. A measured pull is then exerted on the bare end of the wire until a definite length of the insulation is stripped off the wire.

(7) *Refractory Qualities of the Insulation.*

The current will be passed through given specimens of the wire and increased in quantity until the insulation is destroyed and the nature of the destruction noted, whether in the form of flame, charring, etc., etc.

(8) *Ignition Tests.*

The ability of the insulation to resist ignition by some external source of heat similarly applied to all the wires, and the rapidity with which the flame, started at one point, travels along the wire, will be carefully noted.

Besides the foregoing tests as to the quality of the insulation, the committee also proposed testing the conductivity and flexibility of the copper, as follows, viz.:

(9) *Conductivity Tests.*

The conductivity of the copper will be measured, assuming the wire to have the diameter claimed by the makers.

(10 *Flexibility Tests.*

A given piece of wire will be bent repeatedly backwards and forwards around a templet, curved to a quadrant of say one inch radius, the number of bendings required to break it being noted. In order to procure wire of the same quality as that commercially sold in the open market, it was proposed to purchase the specimens tested in the open market direct from the makers.

The second duty charged on the Committee was, as already stated, the preparation of a code of rules, based on actual experience, for the general installation of plants, both so far as concerns the insulation thereof, and for the protection of the plant, consumers, attendants and build-

ings. The importance of a code of rules of this character, relating as it does to the better protection of life and property, is generally recognized, both by electric lighting and insurance interests. It is to the true interests of the electric lighting companies to assure the public that not only can they through electricity furnish a steady, reliable and cheap illuminant, but that such illuminant, if intelligently employed under certain well considered regulations, is as safe, indeed, far safer, than any other artificial illuminant. While, therefore, electric lighting companies should not hesitate at the adoption of the most stringent regulations that experience has found necessary for the protection of either life or property, it is of course advisable that all arbitrary and meaningless regulations should be carefully considered before their adoption by the National Electric Light Association. It has therefore been the aim of your committee to obtain a code acceptable alike to Electric Lighting and Insurance Interests.

As preparatory to the framing of such a Code of Rules, the Committee planned the following work, viz.:

1st. The preparation of a compilation of existing rules.

2d. Obtaining the opinions of the principal electric light and insurance companies, as to the practicability of existing rules and requesting suggestions of such changes or additions, if any, their experience might suggest.

3d. Conducting a series of experiments so as to determine, as far as practicable, reliable data on which a code could be deduced affording the widest latitude to electric light and power companies consistent with absolute safety to life and property.

4th. From the above to deduce a code to be regarded as a preliminary code.

5th. To have printed copies of such preliminary code sent to all electric light and insurance companies for comment and criticism.

6th. To prepare finally a code to be submitted to the National Electric Light Association of America.

In carrying out this branch of its work, the Committee has addressed letters to electric lighting and insurance interests, asking for copies of existing rules, etc. To a certain extent these letters have been answered and copies of existing rules and regulations (though by no means complete), have been received, and the Committee had commenced a compilation of the same. In the desire of aiding the association they hereby respectfully submit such incomplete collection and compilation.

Being forced to abandon their work by reason of the failure of the association to make the appropriation necessary to carry out the same, the Committee hereby submit the above incomplete report, and respectfully offer their resignations as members of the Committee and request that they be relieved from any further work in the matter. Respectfully submitted,

Edwin J. Houston,
Chairman,
Wm. D. Marks,
Carl Hering,
M. M. Garver.

Mr. Kinsman: Is there any item there in regard to the time test—that is, the cracking of the wire.

The President: No, sir.

Mr. Kinsman: I move that that be introduced. I have some experience on wires that tested well before we put them in, but did not stand the pressure of time.

The President: There were no exhaustive tests made by this committee at all. They had completed their work to a point where they required financial aid to carry it on. They applied to the association for that aid. The association was unable to give it, and the committee present this report and resign. It is put in plain and unmistakable language, so that you may know if you want any further work done you will have to pay for it. The paper is open for discussion or for whatever disposition you choose to make of it.

Mr. Eustis: We have had some little experience in wire. A good many years ago, when I was with the Bell Telephone Company, I decided to test a wire there, and made out a report of the wire. It tested splendidly after soaking for about two weeks. I made out my report, but, fortunately, it was not handed in. I put the wire up on the shelf, and glancing at it I saw that the insulation was cracked from one end to the other, showing that while the wire might test perfectly well while still wet, after it had dried out a trifle it was absolutely no good. For practical working it is, of course, a strong point that a wire should last and not become oxidized and cracked. There is also the other question which I think should be brought up here, and that is the question of mechanical injury to the covering—abrasion. We all know wires are strung where they are liable to swing against awnings, the fronts of houses, trees and so forth. That, I think, is also a question which should be brought up here.

Mr. Mason: I suppose we must decide this question now, whether money shall be appropriated for such an object. I do not suppose that another committee could be found who would undertake the work which this committee has declined to pursue and undertake it at their own expense. I wish I could hope that I was wrong on that point; but I do not believe that any committee will undertake an expense of a thousand or two thousand dollars, and pay it out of their own pockets. At any rate, although I am very anxious indeed from my own point of view, that the work which was given to this committee shall be done, I do not feel like asking any committee to bear that expense. It seems to me as if the necessary expense of making tests, the results of which would be so valuable to the members of this association should be met. I want to test this thing and so, to bring it before you, I move that the resignations of this committee be accepted and that their partial report be also accepted, proposing to move the appointment of a committee and the appropriation of a suitable amount of money to enable them to carry out such plans as they shall deem wise for the determination of the end sought by the committee whose resignations are now offered. I move the acceptance of the partial report and of the resignation of the members of the committee whose names are thereto appended.

The motion was seconded.

Mr. De Camp: I understood from that report, as well as from Professor Houston personally, that it is not made in the nature of a report; that they could not report for lack of funds to carry out their investigations. What they have said there is in the nature of suggestion.

Mr. Mason: They use the term partial report, do they not, Mr. President?

The President: Yes.

Mr. DeCamp: I do not think that the committee want to be responsible for that report. The question arose in my mind what disposition we ought to make of it.

The President: You had better modify your motion; this is a report.

Mr. Leggett: I move that the report, which is admittedly incomplete, and for which the committee would not probably want to make themselves responsible, or the convention desire to accept as an expression of its will, be laid on the table.

The motion was put and carried.

The President then announced that The Boston Electric Club had extended an invitation to the members of this association to attend a banquet to be given on Wednesday night at the Point of Pines.

The convention then adjourned until 2:30 P. M.

AFTERNOON SESSION.

The convention was called to order by the President at 2:30 P. M.

The President: The first business of the afternoon session is the Report of the Committee on Electrical Distribution by means of Alternating Currents.

Mr. Slattery: I regret to have to announce the absence of our very able chairman who had to report upon this important subject, secondary generators. In his absence that duty devolves upon me, and I feel the onus of the obligation involved of doing justice to a subject which is fraught with a great many perplexities.

Mr. Slattery then read the report:

REPORT OF COMMITTEE ON ELECTRICAL DISTRIBUTION BY ALTERNATING CURRENTS.

One short year ago the commercial success of the branch of electric lighting in which induction coils are used was by some of our best authorities considered very problematical, but practical use of the induction system has not only succeeded in commercially converting high tension electricity to low tension for electric lighting purposes, but also high tension theoretical opponents by practical demonstration of facts.

Upon the occasion of the last convention, the extensive use of the induction system received its first authoritative indorsement by our esteemed friend Dr. Otto A. Mcses, and although he was by some considered over enthusiastic in his statements, time has served to prove the correctness of his views and the realization of many of his anticipations.

We will go back six months, and, mentally, what do we see in this business from here. A few experimental plants scattered about in various parts of the country struggling for public recognition and with the innumerable detail difficulties, which dog the footsteps of every new departure; difficulties, the magnitude of which are usually in proportion to our ignorance of their nature, and therefore more frequently than not, unduly magnified.

Now what have those difficulties been, and has the past six months' experience enabled the manufacturing companies engaged in this branch of business to eliminate them?

We find there were three factors in the induction system that required all the ability of the electrical engineer to work out and place upon a proper footing, namely, the dynamo machine, the induction coil and the disposition of the external circuit to take the best advantage of the use of the induction coil.

Of course, there were alternating dynamos in existence, as were also induction coils before this lighting branch of business had acquired any prominence, but they were not such as would meet the new requirements.

We will first take the dynamo. It will be familiar to all of you, that no matter how intimately acquainted you may be with the construction of dynamo machines, when you start in to build a new type, your previous experience, however valuable it may be, does not enable you to foresee innumerable detail difficulties which will assuredly develop with practical use, and which take time to ascertain and remedy.

Well, so far as we have been able to learn the weaknesses which developed in this apparatus were first, the liability of the current to jump across the coils in the event of the field being excited with the armature circuit open. This open circuit sometimes happened by a dead cross occurring in some place in the mains, blowing the fuse at the dynamo, thus opening the circuit, and then the field being fully excited the armature would generate an exceedingly high electromotive force for an instant; the current under the circumstances would be very liable to jump across the coils of the armature, and other hurtful effects to the machine would ensue; the remedy for that was inserting at every branch in the external circuit a junction fuse, and at various points along the mains and sub-mains section fuses to such an extent as to make an open main a remote contingency. It was also found that the armatures heated excessively owing to the presence of the plaguey Foucault currents. It was found that this evil could be almost wholly suppressed by building the armature without iron, and avoiding as much as possible the use of masses of metal in proximity with the armature coils. In this connection Siemens' early type of alternating dynamo, slightly modified to meet the new requirements, might read us a lesson.

It was a bold step when the alternating dynamos were constructed with iron cores, and those who make this class of machine for this high tension incandescent business might give us some interesting information. To my mind this iron core construction speaks of disagreeably high temperature. I do not say that they will not be able to present a rational theory why this evil may not be, or has been, greatly modified, but the fact existed in the past, and as far as we have been able to ascertain stands refuted at present. One thing, however, is pretty evident, that just now this type of machine appears to be finding a rather extensive use, evidencing that it must be doing good work. So much for the alternating current dynamo, a machine destined to play a most important part in the future electric lighting business, and in the light of the past experience no doubt should exist in the minds of anyone here that these dynamos in practical use are now almost, if not quite, as reliable as any other dynamo; while coupled with this is the important factor of a pretty close self-regulating property attainable in this system, without the necessity for any particular method of winding, that property following chiefly as the result of the use of the induction coils. It is satisfactory to know that during the probation of this system every accident of any importance which has occurred to the dynamos has been of a purely mechanical nature, and our mechanics have reduced them to a minimum.

No doubt the induction coils have been the source of considerable anxiety, not because there was any obstacle in the way of obtaining high electrical efficiency, as this latter appears not to have been by any means a difficult problem to solve. The source of greatest trouble has been, as far as I can learn, that of insulation. In what form will the weakness appear? has been a question often asked himself by a timid electrician and as usual the most unlooked for troubles developed. At one time an unaccountable defect in the insulation of the secondary coil would occur, cutting out a number of convolutions, thereby causing annoyance by reducing the incandescence of the lamps in its circuit; the remedy was simple—increase the insulation of the wire and exercise still greater care. The same accident would still more frequently happen to the primary coil: the same remedy applied overcame it; sometimes a number of the layers of the primary coil would thus be suddenly cut out, resulting in the passage of a much heavier current than the fuse in the coil box had carrying capacity for; the fuse would then melt and possibly draw an arc that you had a great deal rather do without if you could; the remedy for that was, keep on insulating the primary coil layers from each other until the trouble ceased, and increase the distance between the ends of the primary fuse to such an extent that when the latter melted, an arc, no matter how great its volume, would not be able to bridge over the distance which, after all, was calculable because the E. M. F. was constant. Then again metallic contact would take place between the induction coil and the iron box in which it was mounted, and if that box happened to be placed anywhere near a ground, possibly unpleasant electrical experiences might be related in wet weather. It was again only a question of looking out for the insulation to reduce such defects to a minimum; well, the insulation appears to have been looked out for, as the smooth and safe working of that branch of the business would now seem to testify, and to-day that part of the system can be made as reliable, simple and as easily disposed of as any other part of an incandescent system.

Thus the two new and troublesome factors have gradually and surely been strengthened for their future work.

The next in the system, viz., that method of distribution which would enable you to utilize the induction coil to the best advantage, although apparently presenting the simplest problems at the outset, has required a great deal more thought than was anticipated. It was found that no particular rule, as in the case of low tension distribution, could be carried out, the methods of distribution varying with the condition of the district in which you had to distribute. In some cases the wires were run out from the central station through the centre of distribution, and tapped at any point along the route where lights were required. This was the earliest and simplest form of distribution, and answers perfectly well for comparatively small installations, it being desirable to keep the loss in the mains down to about two per cent. and perhaps about two to or three per cent. in the induction coils, so that the incandescence of the lamps should not vary appreciably throughout the system—this arrangement of the circuit may be carried out in small and very scattered towns, where it has been found to answer admirably. In other cases, where the district is more densely populated and a large installation is required, the inductoriums are placed in the centres of distribution and used like so many stationary dynamos, the high tension primary current with comparatively small conductors feeding each of these centres, the secondary or distributing circuit being taken where lights are required; still other methods of distribution are carried out, but what has been stated in this connection will serve to show that again the past year's familiarity with the business has given an opportunity to perceive and profit by many advantages the system offers.

One of the last but by no means the least point that I shall touch upon in this interesting subject is the question of comparative cost of the main conductors required in installation of an induction, and low tension incandescent plant. Not at all infrequently we shall find ourselves called upon to figure upon a plant like this.

From the source of generation to the point of distribution is one mile and a half, making a three-mile circuit; at the point of distribution you are required to distribute some 400 16 c. p. lamps at say 5 per cent. fall of potential, which appears to be about the limit allowed the induction system. The necessary conductors for this purpose in the induction systems now in use would be No. 2 Brown & Sharpe, which will cost about $230. In the case of the low tension installations upon the low tension system, you would require a conductor costing about $1.050.

Should you be required to distribute throughout the whole of the length of the circuit, the wire such as is used for ordinary arc lighting purposes would be amply sufficient for the induction, and of course a proportional reduction may be made in the low tension.

Now, a great many exaggerated statements are made with regard to the dangerous shocks to be expected from this alternating current, and while I am not prepared to say that the physiological experience of a shock from a thousand volt dynamo is the most agreeable thing in the world, I am prepared to say that the shock is by no means as severe as that received from a continuous current dynamo of the same voltage. A few weeks ago a man showed me his hands, which were horribly burned. He had received a shock from an eleven hundred volt dynamo, and he said with a visible tremor in his arms, as if the recollection of that shock was still vividly impressed upon his mind, that he experienced the effect of that shock for more than a week afterward. A friend of mine was testing a 400 light 1,050 volt alternating dynamo, fully loaded, only a few days ago, and going towards the machine his foot slipped and he fell quite close to it; in his confusion he quickly reached out his hands and unfortunately placed them directly upon the poles of the dynamo. He said from where he fell to the wall behind him was about fifteen feet, and it seemed to him as if that dynamo was suddenly converted into an electrical gun, and he got shot across the room until the velocity of his movement was interfered with by the wall. There was scarcely the appearance of a burn on his hands, merely a pin's head matter, while the effect of the shock was felt by him only for a few hours. It might be said that the difference of the effect of the shock was owing to the difference in the temperament of the two men; that may be so, but I have received three pretty severe shocks from a 1,000 volt alternating machine, and however much I may have felt inclined to dispense with the shaking up

it gave me the experience has been of value to me—one cannot have everything.

One word more in conclusion. The induction system has evidently come to stay, not because enthusiastic advocates think or say so, but because the expert public, the central station public, have practically indorsed it, because it more nearly than anything else meets their immediate and anticipates many of their future requirements. More especially is its advent doubly welcomed just now with this misconducted overhead conductor warfare pressing on every side, and which is every day acquiring seriousness in proportion to the increase of copper wire in the air, and I think that this system, with its comparatively small mass of conductors, will postpone for a considerable time the necessity of going underground with the electric light wires until more extended experiments, shall have given us the confidence in underground systems that experience in the past has materially shaken.

DISCUSSION.

Mr. SLATTERY: If I might make a suggestion, sir, we have our old friend Mr. Duncan present, who is fully charged with alternating effects this afternoon, and we shall be very pleased to receive a shock from him.

MR. DUNCAN: In regard to the alternating current system, I have simply to say that there is no question about the practical and efficient working of that system. There have been some things which required a practical demonstration to bring them out, and there are some things about the system yet which are not fully solved but which are being rapidly evolved. There is no question about the covering of a given space and the distribution of a large number of lights much more economically than there is in a direct system. Now, as to the question that comes up in regard to the difficulties suggested by Mr. Slattery, those are questions which are gradually working themselves out as he stated in his excellent paper. One of the difficulties which was first experienced, as he says, was the induction box itself, but practical experience of four months in the use of that box has been such as to show that in every respect it is entirely efficient, entirely satisfactory, and that it can be relied upon to be placed in any position to do its work effectually and efficiently. In regard to the dynamo, he has gone through that part of it. There is some heat naturally generated from any dynamo. I do not know that I can say that we get any more heat from the alternating current dynamo than we do from the regular arc light dynamo; I do not think we get much less; I know we do not get a great deal more. In the heating of the parts in the original machines that were made there was considerable difficulty. Insulation has been improved from time to time, and at the present time I know of machines which have run successfully for three months, to which nothing has ever been done. Some of these machines will average in a week's run, 24 hours per day except Sunday, and they will be shut down on Sunday for about two hours. In regard to the efficiency of the system, I am satisfied myself, from my own knowledge and from the experience we have had with it, that for long distance lighting, for doing city lighting, for covering a straggling community where the lights will be necessarily very much scattered and where it is not a compact part of the city like most centres, that you can do it more efficiently and more economically with that system than you can with the direct.

Mr. SMITH (Allegheny City Electric Light Company): I would say that I have had some experience with the alternating system in the same company with which Mr. Duncan is connected, and also with another company in Philadelphia, where we started first with the direct system and changed it to the alternating. On some of the points which Mr. Slattery has asked for I may be able to give him some information about. We have found that where we are using the converter system its enormous flexibility enables you to apply almost any system you want. In one of our stations in Pittsburgh where we rent lights in a poor neighborhood, where the majority of places would demand three or four or five lamps, we found it cheaper to place the converters on the place, using either 50 volt or 100 volt lamps, as we pleased. In the other parts of the town, where we found buildings taking ten, fifteen or twenty lights, we found it better to take the high tension right into the building and place the converter in the cellar or the garret. In some cases we have a mixture of the systems. For watchmen's lights we have both the secondary main outside and the converters directly in the building. In very large buildings we carry the high pressure mains over the buildings; that is, through the building, and tap to our converters wherever convenient. In the case of hotels, we have a high pressure wire down to the centre of the corridor, and in the case of a large parlor being lighted, we would put a converter into that parlor. In the case of a row of bedrooms requiring twenty lights, we would put in a twenty light converter. Without the slightest trouble we change buildings having three or four hundred lights from one system to the other without cutting off the lights for a moment, by cutting up the existing wires in the sections and tapping in the converters one after another as we need them. Whenever we wished to change a section we would substitute our 50 volt lamps for 100 volt lamps. When we had all the lamps changed in a building we would splice up where we had cut. In a building having 300 lamps we only put in converter capacity for 200, knowing that no more than 200 lights would be burned at one time.

As regards the danger of shocks, I have had a little experience on both sides. I have had a full share of the arc light shock. I opened a circuit of 1,500 volts, which was sufficient for me. I have also taken a thousand volts alternating, and there is no comparison between the shocks at all. If I may be allowed to give my own experience, I should say that the Thomson-Houston machine gives about the most tremendous blow I have ever felt. It is a peculiar dead stroke which you do not find in the Brush. But the alternating machine seems to throw you off instantly; you do not have time to take hold. We had a case in Philadelphia the other day which I think will be something for Mr. DeCamp to hear, as I believe he feared it was one of his men. (Mr. Smith then related the case of a man who had accidentally taken hold of a lamp socket and completed the circuit through the damp ground on which he was standing. He lay with the 1,000 volt alternating current passing through him for four minutes before assistance arrived. Although blue in face and greatly prostrated he was resuscitated by resorting to artificial respiration.

The structure of the skin had been destroyed, as is usual in all electric burns, and the burn had extended some distance under the skin and had followed two or three inches under the skin. The man said afterwards that for two minutes at least of the time he was on the wire he was perfectly conscious, that he knew his companion was there and he tried to tell him to pull the wire away, but he could not speak, and that when his companion went away he knew perfectly well he had gone for assistance, and then realized that it would be three or four minutes before he got back; and he thought to himself that he could not stand it that length of time, and then he forgot everything. He said that he felt no particular pain. He got a shock that he would get from any electric current, when he first laid hold of it, but after that he felt nothing. The sensation seemed to be like that of drowning.) As soon as we got him to gasp and breathe, the color came back again. This incident has given me quite a new hold on the alternating current system—to know that you can take 1,000 volts of it and stay on it that length of time. I know I should be very sorry to take a direct current, one quarter of that time.

As to the question of heating up of the machines, I would say that on the newer machines, such as we are using now, we run them for a week, starting on Sunday afternoon and running until Sunday morning. It runs from nothing—an amount which you cannot read—to 35 or 40 ampères, and in all that time it never gets so hot that you cannot bear it with your hand with comfort. Of the larger size machines we are using in Pittsburgh, we have one there that has been running two months—a 30-light machine, running 22¼ hours a day. We only stop for ten minutes, and if the engineer does not feel like it, he does not stop even then. The load on that varies from nothing up to 65 or 70 ampères. You can always bear your hand on the machine, and as long as you can bear your hand on it it is certainly not hot enough to injure any good insulation. The converters we know absolutely nothing about. We put them in and that is the end of it. I think we had to take two out on account of the blowing out of the plugs. The secondaries were short-circuited, the effect of which is generally to blow out the primary plug. It does not injure the converter as far as we have been able to find. We have never had a case of a converter short circuiting either in the primary or the secondary. We have occasionally had a converter terribly overloaded, when it will heat up and finally blow the plugs through another converter, which is tapped in on the secondary wire. It is hard to get linemen to understand that where two converters are coupled together and one of them gets hot it is usually the other converter that is at fault. I am a little of an enthusiast on the subject of alternating currents as in Pittsburgh we are using the direct system multiple arc, and we have been struggling with No. 0000 wire pulling our poles out of line and the direct current machine burning armatures. In Pittsburgh we put them to very severe duty, owing to the suddenness with which storms come up there. I have known a current in our station to jump from 300 to 2,000 ampères inside of 15 minutes. But taking the two systems into account, the ease of distribution and the ease of handling, I say that the alternating system is bound to come, if for nothing else, for the enormous reduction it makes in the cost of running your station.

Dr. MOSES: I am very well pleased to hear some of the details Mr. Smith has mentioned. I feel myself a little responsible for the success of that system, inasmuch as I then thought it would succeed, and now I want it to succeed. The alternating current machines which I saw at Pittsburg were running very well, and had only been running for one month when I made that report to the last convention—as my neighbor facetiously remarks, "that very extraordinary report." However, I have just returned from abroad, and thought that before coming here I could not spend the few days necessary to get over the *mal de mer* better than in going to Pittsburg and seeing how that machine was running. I am very happy to say that the same machine is running in that station in South Pittsburgh that Mr. Smith speaks of, with this additional fact, that they have doubled up all around in their capacity—not doubling, however, that lone, solitary man that Mr. Weeks saw there when he meandered through Pittsburgh and looked at the alternating current system. The same man was there. They had doubled up the capacity, but that same one man was running it, and I did not see that he had any more work to do than he had before. They were running 3,000 lights where before they had been running 1,500. While wandering through Pittsburgh and seeing thousands and tens of thousands of incandescent lights which they have about in all directions, I noted the progress that had been made by the principal company there engaged in the alternating current system, and I saw one thing there that I would like to call to the attention of this convention as being one of the most important things in connection with the development of alternating electric lighting that I have yet seen or heard of. When I went there six months ago they were making machines of 500 to 1,000 lights. The other day when I went up there, I saw a 2,500 light machine running and doing its work admirably well, and here is the thing that is so remarkable and that I will call special attention to. The machine simply seemed to have been looked at through glasses of gradual magnifying power; that is to say, the 500 light machine was of a certain size, the 1,000-light machine so much larger, and so on; but it is exactly the same machine in all its details. In a continuous-current machine, if you want to vary the output of the machine by increasing the parts, you will find yourself, when you begin your work, quite at sea. No one can calculate exactly what he is going to get at. True, there is a good deal of pleasure in guessing right, but if you do not happen to guess right it is very disagreeable and costly. But here in the alternating current machine you see a possibility, under certain forms of the machine, of quadrupling the output without changing the form of the machine at all. Now, where is that going to stop? It is only a step to say that they will be making some day, in the simplest manner, 10,000-light machines, that will require no more attention than the same solitary man that we saw at the South Pitteburg station. The strength of the materials is the only limit to the length of the shaft bearing the armature, and I do not see really where the limit is going to be; so, if you want to put in central station work, it seems to be that on an alternating current machine you may do an unlimited amount of work and get rid of all this great trouble you have had in doubling up machines, looking after commutators and all that difficulty which naturally limits the life of a plant. That is a fact that I think will be of value to the convention, and I give it.

Mr. KIMBALL: In regard to the alternating system of supplying incandescent lights, since the last convention in Philadelphia, there has been a marked advance, and from the various installations which are at present in operation we have been able to get data which are not only interesting, but useful, and the question of insulation of the high potential wires is one which appeals to every one in every part of electric lighting stations, whether in the lineman or the central station general manager. In one case it is life and limb; in the other it is property. Regarding the danger of carrying high potential wires into sockets, there are many cases where it is convenient to make an armature instead of putting a converter high up on a fixture in a city where you are not allowed to put it on poles—it is very inconvenient to put a converter for 100 lights on top of a man's building and carry one or two down into a store to distribute the incandescent light, simply because you are running with 52 volt; and if a way can be devised for enabling us to carry safely the currents which, to say the least, approach the intensity of the arc current into our cellars without that sense of danger, it is the thing that is needed at present.

The question of the insulation between the primary and the secondary of the induction coil is one which is governed by a variety of circumstances. Where converters are placed out of doors, moisture will get in and grounds will develop on the high tension wires, no matter how carefully the poles may be wired, either from defective wiring as far as relative insulation in positive and negative wire; or possibly we may have ground wires, and this bold expedient of grounding the inside wiring by heavy metallic lines to the ground has been brought to the attention of this convention before and has been published in some of the electrical papers, and it seems to me that opens a field for discussion. The fact must be appreciated that each system of incandescent wiring from a converter inside a building is entirely separate and completely isolated from every other piece of wiring in the city or town, and that running a metallic ground from one wire to the earth is not to be compared with grounding a positive wire by distribution from 75 or 100 volts; and in such cases should danger develop, being only on one wire, the lead fuse can give way to an excess of current on either positive or negative without in any way affecting the other installation, and in such way give warning of the danger whether in the convertor or in defective wiring.

Regarding the distribution of currents over a large area, in discussing a system of running incandescent lights which requires us to use a little different apparatus, it seems to me that those of us who have the practical work to do are apt to lose sight of the fact that all the laws of wire and construction work which apply to straight incandescent or low tension wiring are applicable to the alternating system and that all appliances which are made for straight incandescent work may be utilized for the alternating current by conforming to the laws which are now so well known regarding self induction and the closed magnetic shield; and it is a question to be decided by the electric light engineers in practice, to determine whether it is better to rely on high potential wires for a system of distribution, and lay them out with as much care as the feeders, mains and systems are now laid out, and then to place the converters as near the lamps as possible—any way they may be required; or whether it is better to run a system of high potential mains and rely on your inside wiring or your placing of your convertors.

Mr. DECAMP: In the report read by Mr. Slattery, he speaks more positively about the difficulty of insulating for this current. On the other hand, he notes that the effect of the current upon a person—and he is corroborated in this by Mr. Smith—is not as great as it is on the direct current. That struck me as being a little inconsistent. The electromotive force, as I understand it, is a very strong element to guard against in making installations. It is what affects the human body. I would like to have an explanation of that. There is another thing I would like to know. The peculiarity of this current is such that the close contact is going to affect the current or going to affect the insulation, making it more or less difficult to insulate. As an explanation of why I want to know that, I would say that we are about to run an alternating current under ground in the city of Philadelphia through an iron conduit. Those are things we have got to contend with. Now, shall we make that conductor of an insulation that requires a second metallic covering such as lead? Do we lessen or do we increase our difficulties by so doing?

Mr. SMITH: I would state that I am not in any way a representative of the Westinghouse people though using their apparatus, but being in the same city as the manufacturer, I have had exceptionally good opportunities for observing their work. In Philadelphia we are using lead and copper cables. We use that because it seemed to us in underground work that the first thing we had to look out for was moisture. We satisfied ourselves that if we could get a good metallic covering it would be probably about as good as anything we could get hold of. Our conduit in Philadelphia is made of a common pine box, in which the cable is laid, and the box is filled with pitch. In that we have iron junction boxes for connecting our feeders into our mains. The outside covering of the cable is not insulated, in any way from the junction box, though, of course, the wire carrying the current is. In some parts of the street where we found it difficult, owing to water pipes, the cable car conduits, and so on, to lay a wooden box, we used the iron pipe through which we pulled these cables and then filled them up with pitch. We filled them up with pitch simply as a mechanical protection to prevent workmen from hammering a pick into them. We have not had the slightest trouble or loss of current or induction or anything else. Our men handle the outer covering of this cable with perfect impunity, and as long as your dielectric is in good shape it seems to me you have something that is perfectly safe. I understand that some experiments have been made by the Westinghouse Company with regard to this very question, and when I put to them the question their answer was that we could use any kind of cable we wanted to as long as the covering was good, but for practical use they would recommend us in this particular instance a lead covered cable having both conductors in the one light covering; that is to say, two separate cables run side by side through their whole

length. And that is the form of cable I have been advocating myself for mechanical reasons. They tested it thoroughly in every way, and told me I would get perfect satisfaction out of it. When we turned the alternating current into our Philadelphia lead covered cable where the cables are run in separate boxes, but grounded throughout their whole length, the question was raised whether static charges would not come into effect and our men get shocks. But we did not find that there was any effect whatever. As to the question of loss of power through induction passing through a metallic covering it might be different with iron. As I say, I have had no experience with long conduits of iron; but it seems to me that if you run your wires close together, any effect you get on one wire when it is positive, would be neutralized the next instant. It is the same way with telephone wires. We have found that if we cross our wires every four or five poles we have no effect whatever in the telephone. In one case, we have the double circuit about 12 inches apart and the telephone wire running on top of the pole, about 7 inches between each wire. There is a continuous musical note, but not nearly as annoying as the buzzing caused by an ordinary arc machine current. We, of course, think that the telephone companies ought to cross their wires, but we do not think we ought to be called upon to be public benefactors to such an extent.

Mr. KINSMAN: Since I came in I heard one or two gentlemen speak of the information they cared to supply in regard to this alternating system. I would like to add one thing that may be of interest. I have succeeded perfectly in burning an arc light with a 50-volt converter from the alternating system of the Westinghouse people. We get 12 hours from 24 inches of carbon, and a light that is perfectly steady.

Mr. SMITH: I would like to ask Mr. Kinsman what is the style of the arc lamp.

Mr. KINSMAN: It was a Simplex lamp, 2,000 candle, 55 volts.

On motion the paper was accepted.

The President: The next paper is that of Mr. E. R. Weeks, of Kansas City, Mo., on

ELECTRICAL EDUCATION.

Few questions of the day are so important as the applications of electricity, and there is none upon which exists such a lack of general information.

The telegraph business is so extensive that people think no more of sending a telegram than of posting a letter; we are beginning to depend upon the telephone as an every-day necessity; the electric railway has demonstrated its financial basis; and the electric light, though a creation of yesterday, is so largely used that about two hundred millions of dollars are invested in its manufacture in America alone. In fact, so many are the practical every-day uses to which electricity is put, that we have not time to enumerate them. Yet the public has more knowledge of almost any other instrument of its convenience than of this one force that first inspired the fear and curiosity of man. Not only is the general public almost wholly ignorant of the principles, uses and modes of application of electricity, but there has been such a scarcity of those who have made a special study of these new branches of industry, that it has been well nigh impossible to secure the intelligent service that many of them require. A man of average education may easily gain the mechanical dexterity, the sensitive hearing, and the rapidity of thought necessary for telegraph and telephone service; but some applications of electricity require thorough, special training for efficient work, and we cannot hope for satisfactory service in the direction of traction and lighting, till this training is furnished.

Electrical engineering is undoubtedly the occupation of the future for the young man who does not care to enter the already over-crowded professions, but whose education fits him for a broader field than that of the trades. It holds out the highest inducements financially, and it is a service in which the intellect can never rust out, as it offers a continually widening horizon of thought; indeed, the possibilities of this profession are as yet practically unlimited. In most fields of labor the best has been accomplished; here the work is in its infancy, and the demand is not only for skilled hands, but for trained and progressive minds. The property involved in the applications of electricity is already immense, and is rapidly increasing; much of the machinery used is most delicate—no unskilled hands should destroy its value or make it render less than its best service. "Electricians" to whom Ohm's law is "Greek," and "experts" who "adjust," but never clean, should not be allowed to multiply.

But how can the special education which shall produce true experts and electrical engineers be obtained? Several colleges have given this department some consideration, but not so much as it deserves. Its training should be both theoretical and practical. A thorough understanding of the theory of electricity is absolutely necessary to enable one to keep pace with the rapid progress in this branch of applied science; and without an intimate knowledge of the apparatus used, commercial success is impossible. Colleges and universities should have well equipped laboratories, and should add to their curricula complete courses in electrical engineering, laid out after consultation with those few eminent electricians who have had experience in the class room, the laboratory, the factory, the station, and who know better than any school recluse what theoretical training is of value.

To receive the greatest benefit from such special course, it would be well for the young man, after completing a thorough basic high school course, to spend some months in an electrical station doing the practical, every-day work there required, and thus gaining a more nearly adequate idea of the information he will need to give him skilled control of the forces with which he is to deal. With this preparation, he will be enabled to take hold of the theoretical work with a zest that can come only from an understanding of what it is to do for him and what he is to do for himself. Having finished his college course, he is not yet to consider himself a graduated expert, but some time spent as a learner in factories and stations should be a regular part of his electrical education.

After fully carrying out such a plan, the young man will be in possession of a theoretical and practical knowledge of the work he has chosen, that will give him access to the most desirable of positions.

The more complicated electrical industries are of such recent date, and their growth has been so rapid, that school-trained workmen could not be obtained. Schools had not time to adapt themselves to the new order of things. Only unskilled labor could be employed, and only such can be had for some time to come. Much of this work has been performed by uneducated men, many of whom have shown that good results may be accomplished without school training or higher mathematics. Thoughtful observation and practical experience have done well for them, but always at the expense of costly mistakes and delays; and at best such labor is limited in its possibilities. Only the trained mind can attain the highest places.

But something should be done to assist the vast army of halting hands that in the near future—nay, in the very present—must do the work, while the schools are preparing for this new field of labor. Ours is not an industry with long years of experience to draw upon, yet it is one in which the unexpected, the unprovided for, is constantly occurring. Therefore interchange and comparison of thought and experience are more necessary here than in other industries of greater age or slower growth. Had this been fully realized in the earlier history of electricity, much of the bungling work of the past might have been avoided; for there can be no doubt that the progress in intelligent service has been greatly retarded by the narrow policy which refused to impart information to the "new man," but which is giving way before the broader influence of our associations. Members of the electrical fraternity are beginning to recognize the truths that knowledge given away is the more securely possessed; and that, as all know more than one, all may be benefited by an interchange of ideas, and employers are awakening to the fact that they must also be educators.

In order that the skill and intelligence of the worker may in some wise keep pace with the rapid progress of electrical invention, every mode of improvement should be employed. The public should be informed upon these subjects and led to take an interest in them. Young men must learn that there is a new, broad and remunerative field of honorable and attractive service.

The National Electric Light Association is doing much, and should do more, not only for the mutual advancement of its members, but to bring the business which it represents before the public in an intelligent way, not at all as an advertisement, but because it is safer, pleasanter and more profitable to serve a people well informed upon our work than one whose fears are multiplied through ignorance. The Edison Association and the Institute of Electrical Engineers are also exerting an influence in an educational way, and the clubs that are springing up in all electrical centres, cannot fail to accomplish a good work in the same direction.

But such organizations, however valuable they may be, can effect but indirectly the large body of men who handle machines and lamps, run lines or serve in any of the branches of a business that needs intelligence even in its firemen. Yet these are the men upon whom the success of the new industry must largely depend.

As intelligent service is the most profitable, employers can afford to spare no expense to obtain it. Every station should possess a pleasant reading room, well stocked with papers, magazines and standard books on electrical and kindred subjects, and employés should be made to feel it part of their daily duty to inform themselves upon all matters connected with their work. From time to time they should be questioned upon important points; and if they cannot be led to do the necessary reading in any other way, they might have monthly grades and ranks determined by the information they have gained from their work in the reading room. All large stations should have mutual improvement societies of the men, furthered and assisted in a personal way by employers, in which the problems of daily work may be discussed, and directions given for useful and telling study by employés who do not well know how to help themselves.

Municipalities should appoint boards of examiners, whose duty it should be to inquire into the competency of electrical employés, especially those of light and power companies, as ignorance and poor workmanship here endanger both life and property. Line and station foremen should be licensed, as their duties are fully as responsible as are those of stationary engineers.

By such legal measures, faulty construction will be prevented, and cities will secure safe and efficient service for the public; will further the interests of workmen; will protect electrical investments, and assist in the education of the people.

On motion of Mr. DeCamp the paper was accepted and ordered spread on the minutes of the association.

Mr. SMITH: I would like to ask if Mr. Weeks could recommend to the convention any practical text books which could be put in the hands of linemen for use in their every-day duties.

Mr. WEEKS: Yes, sir; I think there are a number of books which are sufficiently popular in their style to be of great use to employés. We have a society of our employés in Kansas City on that plan that I have pointed out here, and we have made it a complete success. I think that if Mr. Smith will get a list of electrical works from any one of the electrical papers that he will be able to select from 30 to 40 books sufficiently simple and elementary to form a nucleus for a library of this kind.

Mr. GARRATT: I would say in that connection that I found a little work by Prof. Sylvanus P. Thompson, known as "Elementary Lessons in Electricity and Magnetism." It is a very valuable little work and an inexpensive one, and contains enough material to keep the average workman busy for a long time.

Mr. MASON: There is handed me, sir, the following resolution which I have been requested to read. I will read the resolution and append another:

Resolved, That the work that was assigned to the Committee on Insulation and Installation is of such importance that this convention cannot allow the subject to escape their earnest attention; that the subject is of the utmost importance to the electric lighting interests, and one in which there must be abundant material and experience, which can be obtained without expense to this association; and further, that another committee should be at once appointed to gather information, classify the facts, and then offer them to the convention in form that may be of practical as well as of scientific advantage.

I add this resolution, sir:

Resolved, that a committee of five, on insulation and installation, be appointed to report at the next meeting, and that Dr. Otto A. Moses be the chairman of this committee.

I do not see the necessity of this second part beginning "that the subject is of the utmost importance." If I may I will omit that.

The first resolution was then adopted.

Dr. MOSES stated that while he should be willing to serve he declined to act as chairman of the committee.

The PRESIDENT: I will appoint the committee, and I will endeavor to induce Dr. Moses to serve, if not as chairman as one of its members. With Col. Leggett's consent, I will place him on the committee on Revision of the By-laws. There are two points which he made this morning, and which I concede to be of the greatest importance. First, that the convention should decide where the next meeting of the association should be held; next, that they should elect for president of the association some one in the locality selected for the meeting, believing that rotation in office is a good thing. I have passed the time when I am seeking particularly after glory, and would be very glad to resign the glory and labor to some more competent hands. In making up these by-laws I think it would be well to consider that part of the proposition. The business of the association can be better handled if the president of the association is chosen from the location in which you intend to hold your next meeting. I assume, Mr. Leggett, that you will serve on that committee.

Mr. LEGGETT: I think, inasmuch as I was cut off in my remarks this morning that it would be fair for me to say that as far as I am aware there could have been no better service rendered to our association than has been rendered by our present officers and especially our president; but it seems to me that it is a matter of considerable importance that the officers should be rotated for the special reason which has just been mentioned by the chairman. The meeting in a certain locality ought to carry with it as nearly as practicable the election for that year, at least, of the officers of the association in the same immediate vicinity. Then again, we might at some period be burdened with certain officers whom we do not like, and through a sentimentality which might grow up in this way be burdened in a manner which we might not care to relieve ourselves of; while I am very happy to say, and I know I reflect the sentiments of every member of our society, that the present officers have served us with great ability, I think, nevertheless, that that could be made a part of the constitutional groundwork of our association, in order that no difficulty or embarrassment may arise hereafter in the organization of our society or in its meetings. It was my purpose in speaking this morning to suggest that it be made an element of our by-laws, of our constitution, in fact, to make local changes in president and vice-president—I think it ought not to apply to the secretary and treasurer, because their duties are of such a character that they may properly with great benefit be maintained in the same hands for a considerable period—but that nobody be eligible to the offices of president and vice-president for two successive terms.

The PRESIDENT: I think it would be well to suggest in that connection at this stage that the committee on nomination and the naming of the next convention be appointed now, so that during to-day and the next two days they will be able to canvass that question thoroughly and suggest on the last day of the convention a proper place and the names of officers for the next meeting. To relieve them of any embarrassment, I shall, as soon as that committee is appointed, tender you my resignation as president of the association. That is done so as to facilitate the work we are engaged in now.

Mr. LEGGETT: I want to add in that respect that this same matter was talked over by our present chairman and myself prior to the meeting in Detroit, and it was his own suggestion and desire that that should be the course of our convention.

The PRESIDENT: A thorough discussion of this question took place between Mr. Leggett and myself, and I believe that it is better that the officers of the association should be subjected to some system of rotation. There is an honor connected with the holding of the office of president at least, and we all should be eager to fill that office. I have served my time over and over again, and I would be very glad to hand the gavel to somebody else next year. I hope some gentleman will suggest a committee on nominations and place of meeting.

Mr. MAILLOUX: I move that a committee be appointed by the chair for that purpose. The motion was carried.

The PRESIDENT: I name Mr. Mailloux, Mr. Leggett, Mr. Robertson, Dr. Moses and Mr. DeCamp.

Mr. EUSTIS: I would like to ask for information on one point, and that is that, as I understand it, the election of officers is held once a year. Now, the discussion has been on the subject of electing a presiding officer in the locality where the meeting of the convention will next be held. That same officer will hold office for two meetings. I believe the general practice of the convention has been to vary its place of meeting over different sections of the country. Now that same officer is going to hold his office for two meetings.

The PRESIDENT: In the new constitution provision can be made to meet that point, so that you can have your elections semi-annually instead of annually.

On motion of Mr. DeCamp the convention adjourned until 10 A. M. the following day.

SECOND DAY'S PROCEEDINGS.

The convention was called to order at 10:30 A. M. on August 10, by Mr. Ralph W. Pope.

Mr. Frank Ridlon was chosen and took his seat as temporary chairman.

Lieut. J. B. Murdock read a paper on

ELECTRIC LIGHT FOR THE NEW CRUISERS.

The question of how to best install the electric lights in the new men-of-war has been considered in detail, and it seemed advisable to bring the matter before the National Electric Light Association, that the manufacturers of the country might have the problem presented to their consideration in advance of the time when they would be asked to act upon it. In conversation with managers of various companies, it has been impressed on my mind that the peculiar conditions existing on shipboard are but imperfectly understood, and as a natural consequence they have not as yet been as satisfactorily met in this country as abroad. I am confident that American ingenuity and skill can fully meet our requirements, and hope that the number of dynamos, about sixty, which will be needed for the vessels already authorized by Congress, may be considered as meriting the experiments necessary for their successful installation.

I am authorized to present in a general way the views of the Bureau of Ordnance of the Navy Department on the peculiar conditions to be met and on the best method of meeting them.

In men-of-war the prime requirements of all kinds of apparatus are compactness and lightness. Neither of these is of any material consequence in electric light installations on shore, and both are generally ignored. Attention has there been given mainly to the question of efficiency of conversion, and a glance at the advertising columns of any of the electrical journals shows that the maximum efficiency and best system of electric lighting is possessed by each of a dozen companies. Our conditions, so far as the dynamo is concerned, may be summarized as wishing the greatest electrical output for a given weight and bulk, and although at first thought this may seem to be essentially the same thing as efficiency of conversion, it is widely different.

The following figures of well-known American dynamos illustrate this point. The comparison is made on the basis of "watts of output per pound of dynamo." The weight, speed and electrical output have been obtained in general from the manufacturers, and are given, of course, only approximately. In this comparison it is of course necessary to consider also the sizes and the number of revolutions, the watts per pound increasing with large machines and high velocities. (Table I):

TABLE I.

DYNAMO.	Revolutions.	Watts in external circuit.	Watts per pound.
Edison, No. 20.	800	50,000	6.0
Brush, H. 3.	850	66,000	9.4
American, 50 Light.	875	21,600	5.7
Westinghouse, No. 18.	900	30,000	5.4
Hochhausen, No. 8.	1000	35,200	8.8
Mather, 500 Lights.	1050	35,250	7.4
Weston, 6 W. I.	1050	11,500	4.1
Brush, G. 4.	1050	28,300	9.3
American, 16 Light. Hie.	1075	6,480	4 8
Weston, 7 W. I.	1100	20,125	6.5
Westinghouse, No. 12.	1100	18,000	4.
Brush, F. 5.	1100	19,000	8.5
Thomson-Houston, H. I.	1150	25,600	6.1
Edison, No. 12.	1200	30,000	6.9
Hochhausen, No. 6.	1200	17,600	8.
Thomson-Houston, E I.	1250	13,200	5.8
Mather, 400 Lights.	1300	28,100	7.0
Edison, No. 8.	1400	20,000	6.9
Thomson-Houston, C I.	1500	6,000	5.6

The next consideration is that of the connection of the dynamo to its engine. A starting point is afforded in the rule that belting should never be used on a sea-going vessel. Nothing so radically violates our condition of economy of space as the use of belting. When space is saved by the use of a short belt, the working conditions are comparatively unsatisfactory. Belts are liable to be thrown off by the sudden change of load to which our dynamos are subject, and become a source of danger to the attendants if the ship is rolling heavily. The adoption of friction gearing between engine and dynamo has been suggested, and is probably practicable, but its durability on shipboard, when the motion of the vessel must cause working of the two shafts may not be great. In the navies of Europe, the practice of direct connection is universal, the dynamo shaft being coupled to that of the engine. This calls, of course, for either a great reduction of the speed of the dynamo, or a corresponding increase of that of the engine. It is easy enough to procure an engine running 1,500 revolutions per minute, but it is a very different matter to find one which will govern satisfactorily at so high a speed. So far as I can ascertain there is no automatic engine manufactured in the United States capable of indicating thirty horse-power which is designed for a higher speed than four hundred. I have been informed, however, that some of the type now in the market could be modified so as to operate well at five hundred. I am not aware of any dynamo in the United States absorbing thirty horse-power, which would yield its normal output at even the higher speed. It is much easier to reduce the speed of the dynamo while preserving its electrical output than to raise the speed of the engine. Admitting the desirability of direct connection on shipboard, the problem proposed is the best method of obtaining the same output in watts per pound, at speeds below 500, that are now commonly obtained between 1,000 and 1,500.

The following figures of European dynamos obtained in the same way as those already given for American machines, and probably equally accurate, will show how this problem has been met abroad. (Table II):

TABLE II.

DYNAMO.	Revolutions.	Watts in external circuits.	Watts per pound.
Manchester, No. 6.	350	9,000	3.6
Victoria, H. 3.	350	36,000	9.7
Siemens & Halske.	350	16,000	8.1
Edison-Hopkinson, 10 in L.	350	16,800	2.9
Manchester, No. 7.	400	23,500	4.6
Victoria, F. 3.	400	21,600	8.6
Siemens & Halske.	400	20,000	10.2
Edison-Hopkinson, 15 in S.	420	39,600	3.4
Gramme, H. 2d 225.	450	23,600	8.3
Elwell-Parker.	450	50,000	5.6
Crompton, $\frac{40}{110}$ J.	460	45,100	6.7
Edison-Hopkinson, 8 in L.	525	15,400	3.3
Manchester, No. 5.	525	6,500	4.7
Crompton, $\frac{22}{110}$ J.	550	24,750	6.0
Manchester, No. 6 A.	550	25,000	6.75
Edison-Hopkinson, 10 in L.	550	25,200	4.4
Victoria, D. 2 S.	600	8,400	6.7
Gramme, H. I. c 200.	600	14,000	6.4
Ganz.	670	50,400	9.2
Crompton, $\frac{60}{110}$ J.	675	66,000	9.8
Goolden-Trotter.	765	16,000	6.2

It is necessary to only refer incidentally to a few of the methods by which these results have been obtained. The principal are the elimination of all iron not needed for the magnetic circuit of the dynamo, and the adoption of a type in which the circuit furnishes a framework of necessary rigidity. The magnet core should be of the best wrought iron, this single condition frequently reducing the weight twenty-five per cent. while preserving the output. Armatures of large diameter give high peripheral velocity at low speed, and this seems to recommend the Gramme ring, a large drum armature being cumbersome. The Gramme form has another advantage for ships' use, that it can be repaired or even rewound with the facilities existing on shipboard, although I believe a Siemens winding has recently been perfected, which admits of equal facility of repairs. The use of multipolar machines contributes to lightness, and the Siemens and Halske machine referred to in the preceding table has four field magnets inside a Gramme ring. Flattened ring armatures and multipolar magnets also give large output for the weight.

Every ship, aboard which the electric light is a necessity, should have two similar dynamos, that either may be used at will. At present this precaution is not observed in the Navy. The lighting of the ships by incandescent lamps is under the control of the Bureau of Navigation, and the installation for this purpose consists of an ordinary plant of an engine driving a dynamo by belting. The electric search lights, two of which are furnished to each large vessel, are supplied by the Bureau of Ordnance, the installation for this purpose consisting of a Brotherhood engine driving two "C" Grammes connected direct on the same bed plate. In case of accident the incandescent dynamo will not work the search lights to advantage, nor will the Grammes operate the incandescent lights well. This is of course most unsatisfactory and the need of the service is for a dynamo which will perform either work well, and, if necessary, both at once. Our search lights require about fifty volts and fifty ampères for ordinary work, the current being sometimes increased to one hundred. The lamp is operated by hand in order to fully utilize the radiation from the crater of the positive carbon. The hand lamp and Mangin projector are in use in nearly every navy in the world, for projecting a condensed beam of light to a distance. Automatic lamps do not admit of continuous adjustments as readily as the hand lamp, and are not so thoroughly under the control of the operator. In any search lights the arc may sometimes fail, and it is sometimes advisable to cut the lights out without notice. Large and sudden variations of load are thus liable to occur, and these should not affect the dynamo. It is unquestionable that incandescent lights can be worked from a series dynamo, and search light operated by a shunt machine, but most of these proceedings are makeshifts. It is undeniable that both search lights and incandescent lights can be worked satisfactorily by a compound dynamo. I have been called upon to work all these kinds of dynamos for each purpose, and the compound dynamo works incandescent lights as well as the shunt machine, and search lights better than does the series machine applied for the purpose. I have also worked two search lights and fifty incandescent lights simultaneously from one compound dynamo. Each search light had three-tenths of an ohm dead resistance in circuit to bring the difference of potential down to about fifty volts. There is nothing new in this, but I have so frequently been asked what advantage the compound dynamo possessed, that I have trespassed somewhat on the time of the Convention to give reasons for the opinion that all naval dynamos should be compound wound for a constant potential.

It is probable that many fine new vessels will require electric motors. Some of our gun carriages may be worked in this way, on account of the advantages that an electric motor offers in small weight and bulk, and in the important fact that it is so much easier to splice a broken main than to patch a leaky pipe when steam or compressed air is used for power. Electric motors will be useful for shell hoists and ammunition whips, reducing the number of men employed for these purposes. Here, also, light weight and compactness are absolutely essential, and nine tenths of the motors in commercial use would be barred out as too heavy. A ten horse-power motor, the largest we would probably use, should not weigh over five hundred pounds.

The potential at which the main should be kept, must be determined from the relative importance of the three uses to which our dynamos will be put. As we are not bothered by the question of long distance transmission, we can well use a low potential for incandescent lights and motors, while search lights require only fifty volts, although it is advantageous with any dynamo to have a little dead resistance in the search light circuit. For these reasons I think seventy volts is about the best point for a compromise. This is the voltage used in the French navy, the English working at eighty. If two search lights can be successfully worked in series, the potential at the dynamo might advantageously be raised to one hundred and ten, or even one hundred and twenty volts. Experiments have been made to test this point, but it is not decided as yet. Should there, however, be any material advantages secured in the working of either incandescent lights or motors by the use of a high potential, the search lights could be operated with sufficient resistance to give them their proper potential.

The same requirements of small bulk and weight must control in the choice of engines. The adoption of a compound dynamo throws extra responsibility on the engine, as without constant speed the advantages of the dynamo are not apparent. American automatic engines can easily meet this demand, but most of them are too heavy, rigidity of frame being secured by the use of unnecessarily large masses of cast-iron. One hundred pounds weight per indicated horse-power, with 80 lbs. steam, is a liberal

TABLE III.

DYNAMO.	Revolutions.	Watts in external circuits.	Watts per sq. inch floor space.
Manchester, No. 6.	350	9,000	4.9
Edison-Hopkinson, 10 in L.	350	16,800	6.9
Manchester, No. 7.	400	22,500	6.0
Edison-Hopkinson, 15 in S.	420	39,600	9.1
Crompton, $\frac{40}{110}$ J.	460	45,100	20.3
Edison-Hopkinson, 8 in L.	525	15,400	6.5
Manchester, No. 5.	525	6,500	4.6
Ganz.	670	50,400	20.9
Crompton, $\frac{60}{110}$ J.	675	66,000	26.4
Edison, No. 20.	800	50,000	8.8
Brush H³.	850	66,000	23.5
Westinghouse, No. 18.	900	30,000	5.8
Hochhausen, No. 8.	1000	35,200	15.0
Mather, 500 Lt.	1050	35,250	8.5
Weston, 6 W I.	1050	11,500	4.4
Brush G⁴.	1050	28,300	17.7
Weston, 7 W I.	1100	20,125	5.4
Westinghouse, No. 12.	1100	18,000	4.7
Brush F 5.	1100	19,000	15.3
Thomson-Houston H I.	1150	25,600	9.0
Edison, No. 12.	1200	30,000	7.7
Hochhausen, No. 6.	1200	17,600	13.3
Thomson-Houston, E I.	1250	13,200	8.2
Mather, 400 Light.	1300	28,100	7.3
Edison, No. 8.	1400	20,000	6.0
Thomson-Houston, C I.	1500	6,000	5.9

TABLE IV.

	PLANT.	Connection.	Total weight.	Floor space.	Weight per 16c. lps.	Sq. in. of floor space per 16c. lps.
	1-200 light Brush compound 1-8 in. brotherhood	Direct.	5,500		27½	
Steam yacht "Restless."	1 Arnold dynamo (30 lights) 1 Vertical engine	Friction.	600	6 sq. ft.	20	29
	1 Goolden-Trotter dynamo (75 lights) 1 Tower engine	Direct.	900	5¼	12	11
	1 Victoria dynamo (60 lights) 1 Brotherhood	Direct. 765 Revs.	800	4⅝	13	11
Italian cruisor "Dugali."	1 Parson's dynamo (150 lights) 1 Parson's steam turbine	Direct. 9,000 Revs.	900	6¼	6	6
	(3 plants like above.)					

TABLE V.

	PLANT.	Connection.	Total weight.	Floor space.	Weight per 16 c. lps.	Sq. in. of floor space per 16c. lamp.
U. S. Steamer "Chicago."	2 Edison No. 8 (200 lights) 2 Armington & Sims	Belting.	16,000		40	
U. S. Steamer "Boston."	1 Brush compound (150 lights) 1 Straight Line	Belting.	10,400		70	
U. S. Steamer "Atlanta."	1 Weston 7 W. I. (150 lights) 1 Armington & Sims	Belting.	6,500	105 sq. ft.	43	101
Steam yacht "Alva."	1 Siemens compound (160 lights) 1 Willans' engine	Direct 450 Revs.	6,700	27	43	24
French ironclad "Indomptable."	2 plants each 1 multipolar Gramme (160 lights) 1 vertical compound engine	Direct 350 Revs.	7,040	29	44	26
Torpedo Station.	1 Brush No. 7 special (100 lights) 1 Westinghouse	Direct 700 Revs.	4,000	17	40	25
Torpedo Station.	1 Weston No. 8 special (270 lights) 1 Westinghouse automatic	Direct 390 Revs.	9,300	75	42	41

allowance. In many European engines steel and phosphor bronze have been largely used to obtain lightness.

It may be interesting to compare a few well known dynamos as to compactness, the comparison being made on watts of output per square inch of floor space. (Table III.)

The preceding show a general average of about forty pounds dead weight of dynamo and engine for each sixteen candle lamp, whether high or low speed dynamos are used. In the following special attention has been paid to the manufacture of light and compact apparatus:

As illustrating the advantages of direct connection in economy of floor space and also of weight when care is taken, I have a few statistics of ship installations. (Tables IV and V):

It is noticeable abroad, that with the type of slow speed dynamos established in the markets, the system of direct connection is adopted in many isolated plants on shore. The tendency throughout Europe is to reduce the speed of dynamos, preserving the electrical output by a careful study of details. Few recent machines built abroad are designed for higher speeds than 800, while an American company operating at and above 850 advertises slow speed as one of the advantages of its dynamos.

In this country the naval demand for slow-speed dynamos will be comparatively small, but if it serves to introduce the type into the market, I am satisfied from what has taken place in Europe that the system of direct connection will create a field for itself, as soon as the apparatus can be procured without the heavy expense attendant on special work. It recommends itself in any installation where either weight or floor space is to be economized. I believe it can be successfully utilized in lighting railway trains, especially if, in the near future, railroad companies have to furnish steam for heating purposes. Plants could be furnished small steamers and yachts, in which a common installation could not find room.

There are one or two other considerations governing ship's installations. The principle is the absolute necessity of high insulation. The Bureau of Navigation has, in its recent contracts, called for an insulation resistance of one thousand megohms per nautical mile, after twenty-four hours immersion in salt water.

Lead covering is also required as a protection against mechanical injury. We are so exposed to short circuiting and corrosion from salt water that the high standard called for is most wise. All switches, junctions and safety boxes, and in fact all parts of the circuit should be thoroughly insulated. Difficulty has been experienced from salt water running along the wires into lamp sockets, short circuiting the lamps. The insulation of the whole circuit is sometimes required to be at least one thousand ohms for each volt at the terminals of the dynamo.

Lieut. MURDOCK: One or two things occurred to me while reading the paper. Things which are necessary in marine installations are measuring instruments, both ammeters and volt meters, which are independent of both gravity and magnetism. We want some kind of an instrument like a dynamometer, perhaps, or something of the kind which would be independent of the earth's magnetism and would not be affected by the local magnetism of the ship. Another thing which is necessary is the independence of the needle from the effect of the rolling of the ship. This has been already met by Sir William Thomson in his marine galvanometer and I think in some recent instruments which I have not yet seen. The simplest way apparently is to suspend the magnet or needle or coil by a suspension which passes through its centre of gravity. If this is accurately done, of course the force of gravity has no moment to act upon and the rolling of the ship does not affect the needle at all.

I was requested to present these facts to the consideration of the convention and I have to express my thanks for the courtesy extended in affording me the opportunity to do so. (Applause.)

Dr. MOSES: I listened with great pleasure to that very interesting paper, and as there are some points in it which are of very great interest to a large class of our nomadic population, I would like to ask some questions of Lieutenant Murdock in regard to some statistics which he has omitted. Would he kindly let us know whether he has gathered any information as to the relative methods of laying wires on board ships; that is, are grounds used? Is the hull of the ship used as one of the conductors, or is there a tendency to have the circuits entirely independent of the ship itself?

Lieut. MURDOCK: In England, I know, they use what they call the ship return, or as they prefer to put it, the one wire system, but I do not think anything of the kind has been used in this country and I should think it highly objectionable. All the installation required to be put in is protected by the highest attainable insulation—a double circuit and every part insulated. The system of earth connections has been used for quite a long while in torpedo service. Much of the torpedo apparatus in the Navy has until within the last few years been arranged to work with the earth, but premature explosions have taken place and that has been discarded. To-day, as far as I know, all plants are installed with two wires and high insulation.

Mr. KINSMAN: I would like to ask the gentleman if he knows anything about the experience of the steamship "Alaska." They were at one time giving the one-wire system a test.

Lieut. MURDOCK: No, sir. I know they are using the one-wire system on Mr. Vanderbilt's yacht, the "Alva."

Mr. KINSMAN: I thought they were experimenting with it with the view of putting it on other steamships.

Dr. MOSES: I was crossing in the steamer "Bourgogne," of the Compagnie Trans-Atlantique, and we had made a very rapid passage and everything was very lovely, when about four hours from Havre people began to be disturbed because the previous ship, the "Champagne," had been run on the rocks at about that distance from Havre. We were talking of the matter, and all of a sudden we saw a stir about the ship and found the captain and one or two officers disappear, and we all made a start to find out what was going on. We found about 20 feet of the molding smoking heavily, and the firemen were at work tearing it down. When we got there, we found there was the beginning of what might have been a serious fire; it was started by the defects that Lieutenant Murdock spoke of in the insulation. It is the hardest thing in the world to keep an insulation on a sea line. All of you who have houses at the sea shore will have noticed that where the verandah or piazzas are painted with metallic paints there is a tendency to decomposition by the chlorides of the sea air attacking the carbonates, decomposing them and making them soluble as chlorides of lead or zinc, and you have the bare wood toward the sea and the rest of it nicely painted. If you want to make a good paint for a sea house use the worst paint you can get; that is, carbonate of baryta which would not be decomposed. All these insulations are affected by the chlorides that come from the salt breeze. In this particular case I took occasion to inquire into the subject. The hull of the ship was used for the return wire, and when I inquired into it—although the crew and officers were very well disciplined and very reticent—I found they were always on pins and needles for fear fires would break out. Further investigation led me to find out that there had been a previous accident of the same kind, and although it looked very pretty it is a highly dangerous thing, and we ought in some way or the other to protest against it, because those accidents, if they occurred in time of danger, when people would be compelled to take to the boats, and the decks would be yawning, would be accompanied by twenty or thirty feet of fire combined with the other horrors. We ought, therefore, to protest against such a thing, as by such a paper as that we do in the best way.

Mr. MAILLOUX: I would like to ask Lieut. Murdock a question relative to the number of hours during which the energy is to be employed on board ship—whether the time of use will be pretty well distributed over the twenty-four hours of each day, or whether there will be parts of the day when the source of energy will be at rest, not being used.

Lieut. MURDOCK: I suppose that ordinarily the incandescent light burns all night from before sunset until after sunrise. In some of the vessels, as in the monitors, I imagine the incandescent circuit may be partially used all the time.

Mr. KINSMAN: I would like to ask the gentleman another question, and that is as to the average life of the incandescent lamps on board ship as compared with that on terra firma.

Lieut. MURDOCK: I think there we work with a large factor of safety. They generally run them low. I have only been on board one vessel installed with the electric light. I found that a 16-candle lamp gave sufficient light when burned at 13. When a vessel is going on a long cruise it is a great advantage to save the lamps. I think in almost every case on a man-of-war the lamps will be burned under power.

Mr. KINSMAN: Do you think life would be as long under similar circumstances?

Lieut. MURDOCK: I think so, yes. As far as the lighting is concerned, the only difference is in the vibration, and there may be some kind of carbon that would not be effective. If the carbon was elastic and would be able to stand the vibrations, and especially if the lamp were put on a spring socket, I think the lights would last as long as in a good installation ashore. The discharge of heavy guns in the case of the "Atlanta" broke, not the carbons, but the lamps. The lamps were left in the sockets in some cases to test them and the glass itself was fractured. When the glass goes it is of no use to try and protect the carbon.

Mr. RECKENZAUN: I should like to ask Lieut. Murdock whether he has ever tried Ayrton & Perry's meters on board ship. These meters are protected by an iron shield which renders them independent of any magnetic influence. There is no necessity for the meter to be put perfectly level upon any table or any particular spot where the measurements are taken. I should like also to point out in connection with this subject that in British men-of-war it is the tendency to use the double-wire system, because, by using the ship's side as a return, there is a large liability for leakages, as pointed out by Dr. Moses.

Lieut. MURDOCK: I have not been able to use the spring meter on board ship. With a Cardew volt meter the needle would vibrate about 4 volts, and with the Ayrton and Perry ammeter it seemed to vibrate about the same number of ampères. I do not know of anything in the market to-day better. I believe in the British Navy they have been using a portable form of Siemens' dynamometer, and some of them have been ordered here in order to test them.

Dr. MOSES: I am sorry to trouble you again, but there is some further information I would like to elicit. Signaling, I presume, is a very important thing on war ships, and it is very necessary that you should be able to use both small and large lights. Now, is it your experience that a 100 or 110 volt circuit is adapted to the use of arc lights, or would it not be preferable to have a 50-volt circuit on board ship, so as to be able to use your arc lights directly in multiple arc?

Lieut. MURDOCK: I have recommended in the paper 70 volts. Of course, our experiments with these search lights have been going on a great many years, and the general tendency seems to be that at least a tenth of an ohm dead resistance has a very steadying effect on the light, no matter whether we use a hand lamp or an automatic lamp. A little dead resistance seems to give us better working. The search lights are used so seldom, and our general method of working is so economical, that we do not care for the energy we waste in these dead resistances. The search-lights themselves are of French manufacture, though I think the Brush Company, of Cleveland, have made essentially the same apparatus. I must confess, perhaps, to a little disinclination to use an incandescent lamp at 50 volts. I would rather take a little higher potential and work a lamp of about 4 watts per candle and try to get more light in a shorter time.

Dr. MOSES: Have you ever visited the installation on board the United States Fish Commission Steamer "Albatross?"

Lieut. MURDOCK: I am familiar with the details but have never been on board the vessel. They use the old Edison S-lamp. Of course if we want to take a S-lamp with 55 volts we can do it better than with a 16 candle lamp of the same potential.

Dr. MOSES: On a recent visit to Pittsburgh, I saw everywhere installations of 50 volt lamps. It appears that the Westinghouse Company, of Pittsburgh, have adopted that as a standard. Their reason for adopting it, as I am told, is on account of the economy of the lamp. They get greater watts per candle-power. That, it seems to me, also permits of the use of arc lights directly in the circuit. Incandescent light people, as a rule, neglect the arc lamp and arc light people neglect the incandescent light. It seems to me there should be an imitation of the harmony that prevails here, and they should unite in one system the advantages of all. Arc lights should be used with incandescent lights, and yesterday some one—I think Mr. Smith, of Pittsburgh—suggested that an arc light can be used direct from converters. If Mr. Smith is present he will confirm or deny it, but I presume it must have been on a 50 volt circuit.

Mr. SMITH: It was Mr. Kinsman, of New York, who mentioned that. It was news to me.

Mr. KINSMAN: Some seemed to question the ability of the lamp to run on very high voltage. They asked me, after the adjournment, if it was possible. I have run them equally well on 100 volt converters; 50 volts is, however, desirable.

Mr. DECAMP: May I ask if there is any loss of current in running it on a 100-volt current?

Mr. KINSMAN: They are obliged to lose some. I have not the data with me. We have reduced it very much from what it was a few months ago, and we hope to eliminate the whole of it and I think we shall very soon. One of those lamps that I spoke of I operated with less than a quarter of an ohm's resistance.

Dr. MOSES: The discussion brings out facts that have occurred to me that will answer some of the points that have been raised and some of the questions asked. I happen to have made the first experiments on board the steamship "Albatross" that I spoke to Lieut. Murdock about, with the use of an arc light on incandescent light circuits. It was a 55 volt circuit. It was a lamp directly in the circuit and one that was operated by a function of the current, and the lamp was invented to run on incandescent light circuits. While there it was found, after a great many experiments, that there was a normal length of arc. You may, of course, draft lamps for any voltage, but it is found by experience, taking carbon in its chemical composition and the tendency to an extinguishment of the arc, that a certain length of arc, perhaps from an eighth to a quarter of an inch, is best adapted to arc lighting. For that reason it is necessary to have about 45 volts between the terminals of the lamps, and if you are running a 55 volt circuit it gives you that limit of loss which enables you to run out to any length right from the incandescent circuit of the ship. In this particular case there was about one-eighth of an ohm put in. It worked very satisfactorily. There was no winking of the lamps at all. The lamp itself was designed for a 55 volt circuit; but the difficulty of putting lamps in series on a multiple arc circuit is so great that it is not advisable. Therefore, the adoption of a 50 or 55 volt standard enables us to harmonize the arc and incandescent light in a most remarkable way. You can use your lamps directly from the circuit and that there are places, of course, no one will deny, where an arc light is far superior to an incandescent light. It gives you five times as much light per pound of coal burned and for large spaces it is very much more useful; so that it will be very desirable to adopt some general system where arc lighting and incandescent lighting could harmonize.

Mr. KINSMAN: The lamp that I have reference to has been wound so that we have successfully burned two lamps, that is, in multiple series on a 110 volt circuit. I have not the slightest doubt but that it can be successfully done by the lamp in a very short time. That brings the thing down to a commercial basis and under all conditions.

Dr. MOSES: But you must use two lights together. If you only have one you are compelled either to throw your superfluous power into resistance or into the light that is in use.

Mr. KINSMAN: In general installation, we are not going to put up two lights where they are not needed. Where there is only one light we keep it in that way.

Mr. WRIGHT: Lieut. Murdock speaks of one of the requisites for ship installation being the settlement of the voltage. I think that difficulty is entirely overcome with the alternating current system, as we can supply a converter to give you any voltage you please from our primary wires.

Lieut. MURDOCK: I am glad Mr. Wright suggested that. I think there is one objection to the alternating current on board ship, and that is for search lights. Our hand glass is rather a peculiar institution. The carbons are inclined at an angle and placed out of the line, the positive carbon being uppermost, so that the crater is turned toward the mirror.

Mr. WRIGHT: I think there will be no very great difficulty about that.

Lieut. MURDOCK: As most of the light is given off from the end of the positive carbon in a continuous current I fear that in an alternating current system we lose this advantage. As we are trying to get a system which will use either arc or incandescent lights from the same dynamo, the alternating current in this respect does not seem so good. I do not know that I fully comprehend Dr. Moses, but in the system I speak of we work our arc lamps parallel with each other just the same as we put in an incandescent lamp.

Dr. MOSES: I would state more fully then that it is desirable, of course, to run an arc lamp exactly like an incandescent lamp, since the function of the arc is such that it is equivalent in a certain ratio to the constant resistance of the incandescent lamp if you only give it time to act. The arc is a constant for every voltage, so that if you use a multiple arc arrangement and you have a 50-volt circuit, since the arc for a 50-volt lamp is best adapted for arc lighting, it is advisable to use the 50-volt circuit for that purpose, putting two lamps in series, or to throw in a considerable amount of resistance if you use a 70-volt circuit, as you suggested.

I would just say that there were some experiments carried on by Captain Tanner and myself on the "Albatross" for the purpose of using a search light. In fact, we used this arc light as a head light going around Wilmington and found in a storm that it worked very well, but an arc light can be used on an alternating current, and if you use it for a search or signal light the alternating current presents peculiar advantages. You have your reversals of current and you can make your flashes and signals come in with your alternations of currents. You could alternate the flashes very nicely in an alternating system.

Mr. KINSMAN: I would like to ask Lieut. Murdock if he has any difficulty in the feed of the search lamp, and what the nature of the difficulty is.

Lieut. MURDOCK: I am afraid if I go into that I shall have to describe the lamp.

Mr. PHELPS then moved that the paper be accepted, with the thanks of the association, and entered in the proceedings. The motion was carried.

The CHAIRMAN: I am very sorry to inform you that I hold in my hand the resignation of Mr. Morrison, presiden-

of the National Electric Light Association—something I did not expect.

Dr. MOSES: I move that it be indignantly refused.

The motion was numerously seconded, and carried unanimously.

The next business called before the meeting is the report of the Committee on By-Laws. On motion of Mr. A. J. DeCamp, it was made a special order for the next day's session in order to more fully complete it.

Mr. CALKINS, on behalf of the Committee of Arrangements, made some announcements with reference to the excursion.

The CHAIRMAN: I have also an invitation here from Mr. Meigs, of the Elevated Railway, East Cambridge. I have also an invitation from the New England Telephone and Telegraph Company to visit their works, and asking us to designate a time when any or all the members will make this visit.

Mr. DECAMP: I would like to lay before you a communication which is a matter of information. It is not information growing out of any official action of this association, but it is a matter with with which you are all more or less familiar, and several questions have been asked me in reference to it. The secretary will please read it.

The secretary read as follows:

"The committee of the association of electric light companies for mutual protection against exorbitant prices of carbon, after careful deliberation on the subject, desire, to announced that in view of the collapse of the late carbon combination and the unsettled condition of the market, it is not deemed advisable at present for the association to take further action toward establishing a manufactory or the concentration of a large number of contracts for carbon, believing fully that the individual companies will experience no difficulty in placing their orders at fair and satisfactory prices. W. S. FREAR, Secretary.

The secretary read the resignation of Mr. Charles Cooper as treasurer of the association, which was accepted, with the thanks of the association for the services he had rendered.

The next paper read was that of Dr. Leonard Waldo, on

AN INSTRUMENT FOR BENDING TESTS OF LINE WIRE.

In looking over some specimens of wire which were sent to the Baltimore & Ohio Telegraph Company, Mr. Wm. Maver, Jr., and myself were very much impressed with the uncertainty of the bending test of line wire. Very simple devices are oftentimes very advantageous in use, and I thought it might be of interest to tell the convention of a simple tool which will give more or less uniform results in the bending tests. The objection to taking a piece of wire in your hand and bending it, as is ordinarily done, is this, that a piece of wire bent at an angle here (illustrating) will break, not in proportion to its strength or its value as a wire, but in proportion to the diameter of the wire and its crystalline structure. A very hard drawn wire, for instance, will break with much less bend around a sharp angle than around an angle of its own diameter. I notice that in all the tests prescribed by the division of postal telegraphs in England Mr. Preece is careful to insist that the wire be bent around its own diameter. Any of our hard drawn coppers will break after one, two or three bends. The little instrument which Mr. Maver and myself constructed is merely a pair of pliers which can have a pin of different sizes inserted at its centre of motion, and will grasp the wire uniformly, and it is meant to be screwed to a board, so that the angle at which the wire finally breaks on the last turn is accurately shown. I think as the mechanical properties of wire come more and more into consideration and become more and more desirable, as they rapidly are becoming, that it is extremely important that we have a uniform system for this bending test, and I do not know of any better condition than that the wire shall be bent around its own diameter, a pin of its own size held by some such instrument as this, and that the number of degrees that it takes on its last turn shall be registered. For instance, we know that a wire will take three right angle bends, and we will say fifty degrees more. You can make any simple arbitrary convenience as to the number of degrees of bending that a wire will stand, and, as many of our wires will break at a single bend or bend and a half, it is very important that we keep the last number of degrees which the wire bends in order to have any indication of the mechanical value of these high grades and hard drawn copper conductors. This little instrument will lie in the parlor of THE ELECTRICAL WORLD for you to inspect. It is very crude; it is the first one that was made. Of course, the next one will be simpler and better. (Applause.)

Dr. Waldo then made the following remarks on

SILICON BRONZE WIRE.

In a discussion with Mr. Preece and also in correspondence with the firm of Lazare Weiller & Co., of Paris, I became a good deal interested in this silicon bronze question. I take it that we can look upon all conductors of electricity as merely transparent to electricity, so to speak, and that electricity will travel through them a good deal as light will travel through glass. (Applause.) In our dense ignorance as to the ultimate nature of electricity, of course, we can only surmise in regard to this point, but I take it that it is a good practical conception to bear in mind. Now it has been found that very small quantities of alloys of the earthy metals introduced into a very good conductor has very much the effect of the introduction of a small amount of iron, or any discoloring influence into glass, upon the transmission of light, and that has been found particularly true of some of the earthy alloys, arsenic, for instance, and phosphorus and silicon. But there is also a peculiar physical change which takes place when silicon or phosphorus is added to the bronzes. What that change is I do not know; but in thinking the matter over it has seemed to me that the addition of a small amount of silicon or phosphorus must enable the atoms of molten copper to effect a certain nearer relation to each other—that the centres of the atoms, so to speak, are allowed to come a little closer and that the tensile strength is much increased by the addition of these small quantities of the earthy alloys. But whatever the cause may be, it is an experimental fact that the addition of small quantities of phosphorus and silicon, and perhaps some other alloys, has given us bronzes which have high tensile strength without any greatly lessened conductivity.

Now I began a series of experiments on silicon and its application to these bronzes, to see whether we could get conductors which should have mechanical properties of a high order and at the same time have the transparency to electricity which copper has. The first results of these experiments, after two years of work, are beginning to show themselves, and I have here a number of specimens (which I shall be very glad to give to any person interested) of some silicon bronze conductors in which a high tensile strength has been obtained by using a core of silicon bronze and a covering of copper. You are all aware, perhaps, that some of the French engineers have made stretchings of a mile between supports in some parts of Algiers of very hard drawn pure silicon bronze wire. But the trouble with it is that the conductivity is no greater than the conductivity of steel, and for most of our purposes we want high conductivity. So I was led into a variation of the ordinary form of conductors and returned to the idea of a cored wire. It was found possible to push the construction of pure silicon bronze conductors up to a tensile strength of 120,000 pounds to the square inch, and that rivals the tensile strength of the best steel. But as a conductor for large currents that was comparatively useless, and I, therefore, was led into the experiment of coring the wire. I think, by common consent, the disadvantages of the old style cored wire arose largely from the difference in electrical conditions between the core and its surroundings. If any moisture got between the steel core and the copper covering we had a perfect electric pile, and a certain amount of disintegration would take place between the core and its surrounding. Now that difference of potential does not exist between the bronze core and the copper covering of a silicon bronze wire, because they are so nearly alike chemically, and their electrical condition is almost identical; but there is another very great advantage. The fusing point of silicon—that being an alloy of copper—is slightly lower than the fusing point of copper itself, and it became possible to put in ingots of silicon bronze and to cast around these ingots pure copper. There would be a perfect joint of fusion, so that when the ingots were taken from the molds there was an ingot of silicon bronze covered with copper which would have a perfect mechanical homogeneity, and those little samples which have been passed around the room are specimens of wire drawn with a silicon bronze core with the ends polished, so that you can see there is a difference in constitution of the metal. But it is almost impossible to separate the silicon bronze core from its outside covering. This is a more or less complete solution of the problem of having electric light conductors of very considerably more tensile strength than anything which copper can give, and yet possessing almost the conductivity of copper. In the case of smaller wires the amount of success reached is equivalent to about the following figures: A wire $\frac{103}{1000}$ of an inch in diameter will break at about 650 pounds, and for torsion and bending it is much more satisfactory than the best hard drawn coppers which we have been able to get. You have, too, variable quantities of conductivity and the tensile strength, and you can save either, at the expense of the other; so that it becomes possible, by using the silicon bronzes, to vary for particular conditions either of those qualities; and I think the experiments which we have made bid fair to be succesful in producing permanently a conductor—not, perhaps, better than copper, because we purify our copper more and more, and the present conductors of copper will undoubtedly be increased—but a conductor which is very good and which will possesses mechanical properties which thus far have not been available.

One thing more as to the ultimate course of experimenting in this direction. The silicon bronzes made in Europe have been expensive because of the prohibitory prices put on by the owners of the only patents under which they could be made—the Lazare Weiller patents—but owing to the genius of the Cowles brothers in the working of their smelting furnaces, by which silicon can be reduced from its quartz in a much less expensive way than any other that has yet been tried, and in consequence of the low price of silicon, these silicon bronzes will be made doubtless at a cost which will not at all be prohibitory for their use in places where wires happen to be swung from supports and tensile strength becomes of great value. (Applause.)

Dr. MOSES: Mr. President, the very interesting remarks of Dr. Waldo have elicited from my neighbor here a comment which I would like to bring to the attention of the convention. He suggests that perhaps the hard drawn core, being more slowly acted upon by its own weight in stretching, would perhaps break after the outer covering had yielded. In experiments on the tensile strength they are conducted so rapidly that there is no opportunity that I see for fatigue of metals becoming a factor. It recalls to my mind a remark that was made to me by one of the engineers of the Brooklyn Bridge. He said that he was anxious, in the course of a good many years, to find out what the effect would be of the introduction of quite a number of what are called hard wires into the cables of the Brooklyn Suspension Bridge. It appeared that some dishonest contractor had given, strange to say, a better wire than he was called upon to give—that is, a hard wire instead of a soft one; but it had come in the course of his manufacture and he had thrown it into the lot of wire forwarded and in the tensile strength experiments made, it was found to be unsuitable to the bridge, but still he found a means of getting it in. I believe the man is suffering to-day for it in one of the penitentiaries. The conditions were similar to those spoken of by Dr. Waldo, though not exactly the same. The hard wires are supposed to be in that condition, that, yielding less than the soft wires, the ultimate strains will be drawn upon by the fatigue of the metal in the course of years, so that these wires are, practically speaking, getting the whole strain upon them. I mention this so that in conducting further experiments if you can introduce time into the experiments so as to see the effect of fatigue on the copper covering it will be a very interesting thing.

Dr. WALDO: I think the whole question of the mechanical testings of wire is one of extreme importance. I have been very much struck in testing long series of wires, with the disturbance caused by this very fatigue of the metal of which Dr. Moses speaks. In using a testing machine for testing strengths, it is of the utmost importance that the strain be applied very gradually because you could all get different results in a machine where the strain is applied gradually at an interval of several minutes, we will say, for each wire, and where the strain is applied rapidly. I, for one, would like to see a committee or some representative body which should take under consideration the unifying of the mechanicl tests for wire for electrical purposes. I think both the bending and the torsion and the breaking tests are all now made very much as a particular whim of the company or person using the wire prescribes, and if we had a uniform method of making these tests we should have data for preparing conductors mechanically in a way which is not now possible. I do not know but that I am ready to make a suggestion that a committee be appointed having for its province the consideration for report at some future meeting of the convention of the best means of establishing a uniform system for the mechanical testing of wire for electrical purposes.

The chairman appointed Dr. Waldo and Dr. Moses as such a committee, and left it at the discretion of the president to add it to the Committee on Insulation and Installation.

Mr. MAILLOUX: In regard to the conductivity of copper, I would like to ask Dr. Waldo whether electrolytically produced copper has ever been used in making wires. I have had considerable experience in making copper by electro deposition, and I found it is possible in that way to make a copper which is not only very pure, sometimes 999 fine, but which is also a very ductile substance, and it can be bent a large number of times without showing an absolute rupture, and it seems to draw out in bending, so that the broken ends look very much like an electric light carbon, for instance. It occurred to me that perhaps some attention should be given by wire makers to the use of that kind of copper.

Dr. WALDO: We confined our experiments at first to copper which was electrically deposited on the cores, and we obtained some remarkably fine specimens of wire in that way, but the cost of the process was prohibitory, and the copper which I have used frequently is merely the highest grade of Lake Superior copper.

Mr. MAILLOUX: Referring to electrolytically deposited copper, I did not mean that it was deposited on a core by electricity, but I referred rather to copper which has been produced in the form of slabs by means of electrical deposition. There is now a firm here in New York that has produced, I understand, some 500 tons of plates of copper per month by means of electrolysis, and I meant particularly, copper which can be used in ingots just like any other form, except that it is very pure and exceedingly ductile.

Dr. WALDO: There is great danger in the melting of copper. One of the most insidicus difficulties in the manufacture of high grade conductors is the introduction of a sub-oxide and protoxide of copper as an impurity, and I am very much afraid of any process which involves the constant melting or re-melting, and I should be afraid that electrolytically deposited copper would lose all it would gain, by being electrolytically deposited, in any ordinary process of melting. The protection of that copper during melting has been one of the most serious difficulties that we have had to face.

Dr. MOSES: In the refining of copper the solution of protoxide of copper in the copper itself is one of the difficulties in the way of getting a pure copper by ordinary smelting processes, because it seems to disseminate itself so thoroughly in the mass of the copper. Now, in electrolytically deposited copper, that is not the case, but there are other objections that Mr. Stanley speaks of, and I wish he would bring them before the convention.

Mr. STANLEY: I should like to ask the gentleman if he has ever thought of the self-inductive action of a compound wire having a bronze core and copper sheath. It seemed to me there might be a secondary action set up in that core that might be very prejudicial to the use of it in alternating currents.

The convention then adjourned until the following day at 10 A. M.

THURSDAY MORNING.

The largest part of the session of Thursday morning was occupied by a discussion on changes in the constitution. It was participated in chiefly by Dr. Leggett, Messrs. Phelps, Garratt, De Camp, Duncan, De La Vergne and Eustis. It resulted in the adoption of the constitution appended:

A NEW CONSTITUTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The name of this association shall be "The National Electric Light Association."

Members of this association shall be companies, firms or persons operating electric light and power stations for public or commercial purposes, manufacturers of electrical supplies and apparatus. Electricians, electrical engineers and persons, firms or companies whose professions or business is directly collateral thereto, may become members upon the recommendation of the executive committee and approved of by the association.

Each member in a vote by ballot shall be entitled to one vote.

A ballot may be demanded by one-fourth of the members present.

Persons may become honorary members without the right to vote by ballot of the association.

The officers of this association shall be a president, two vice-presidents, treasurer and secretary, and an executive committee of six members, the president, vice-presidents, treasurer and secretary being members *ex-officio*.

The president and vice-presidents shall be elected by ballot to serve from the close of the annual meeting at which they are elected until the close of the next annual meeting.

The treasurer and secretary, who may be one and the same person, shall be nominated by the president, subject to the approval of the executive committee. The executive committee shall be chosen by ballot each meeting, either annual, semi-annual or special, to hold office from the close of the meeting at which they are elected until the end of the meeting at which their successors are chosen.

The duties of the several officers shall be those usually pertaining to their respective offices.

The treasurer, secretary and executive committee shall make a written report at each meeting to be spread upon the records of the association.

The executive committee shall be the governing body of the association, three of which shall constitute a quorum. They shall meet from time to time and shall report upon application for membership, gather and prepare information upon topics of interest, and arrange for their discussion at the several meetings of the association.

The annual meeting of the association shall be held in February, and the semi-annual in August each year, at

such place as the association shall determine, and such date as may be determined by the executive committee.

The membership fee of each member shall be $10—which shall accompany the application.

The annual dues shall be $10—payable in advance, and shall cover the calendar year.

All amendments to the Constitution shall be presented in writing and referred to a committee to be appointed by the chair before being acted upon by the association; a two-thirds vote of those present shall be necessary to their adoption.

A ballot on such amendment may be called for upon the request of five members of the association.

The discussion of the report of the committee on the wire gauge was taken up.

The CHAIRMAN: The convention made the subject a special order for to-day. The question was upon the adoption of a report.

Mr. PHELPS: I have a resolution to present, as follows:

Resolved, That the report of the committee on wire gauge be received and the committee discharged with the hearty thanks of this association for the valuable work accomplished by them and presented in their tables. It is further

Resolved, In view of the large number of gauges already in existence, and the confusion arising in their use, that it would, in the judgment of the association, be inexpedient to promulgate an additional gauge. The association earnestly recommends to its members, and all others using copper wire, the practice of designating sizes by definite diameters, such practice having already come into extensive use as a feasible escape from confusion among gauges. The association, however, recommends the use of the metric gauge and its fractions in designating diameters, and in furtherance of that end publishes the tables presented by its wire gauge committee."

Mr. MASON: I made the motion that this should be the order of the day for this morning with a view of prepar-

Committee on Wire Gauge:

ALLAN V. GARRATT,
M. M. M. SLATTERY,
HERBERT H. EUSTIS,
OTTO A. MOSES,
H. D. STANLEY,
P. KEILHOLTZ.

National Electric Light Association,

IN

CONVENTION,

AT

Boston, - - - August 9th, 1887.

Calculations made by

ALLAN V. GARRATT,
HERBERT H. EUSTIS,
P. KEILHOLTZ.

In pursuance of the vote of the Convention, held at Philadelphia, in February, 1887, the following mathematical properties of the Metric Wire Gauge are respectfully submitted.

ALLAN V. GARRATT, Chairman.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Gauge No.	Diameter.		Sectional Area.		Weight per Length.		Length per Weight.		Resistance in Legal Ohms Pure Copper, at 0° Centigrade.				Logarithms of Sectional Area.		Square.	Nearest Corresponding Number.	
									Ohms per Length.		Length per Ohms.						
N	Millimeters.	Inches.	Sq. Millimeters.	Sq. Inch.	Kilogr'mes per Kilometer.	Pds. per 1000 ft.	Kilometers per Kilogramme.	Feet per Pound.	Ohms per Kilometer.	Ohms Per 1000 Feet.	Kilometers per Ohm.	Feet per Ohm.	Log. Sq. millimeters.	Log. Sq. Inch.	Square of Gauge Number.	In Brown & Sharp Gauge.	In Birmingham Gauge.
1	.1	.0039	.0079	.00001	.0699	.04692	14.306	21313.	2034.2	620.000	.00049	1.6129	-3.8950899	-5.0854427	1	38	36
2	.2	.0079	.0314	.00005	.2796	.18767	3.5765	5328.5	508.23	154.900	.00197	6.4556	-2.4971499	-5.6875027	4	32	33
3	.3	.0118	.0707	.00011	.6291	.42226	1.5896	2368.2	226.02	68.889	.00442	14.516	-2.8493325	-4.0396853	9	29	30
4	.4	.0157	.1257	.00019	1.1184	.75069	.89413	1332.1	127.14	38.750	.00787	25.806	-1.0992099	-4.2895517	16	26	27
5	.5	.0197	.1963	.00030	1.7475	1.1730	.57224	852.55	81.367	24 800	.01229	40.323	-1.2930299	-4.4833827	25	24	25
6	.6	.0236	.2827	.00044	2.5164	1.6891	.39739	592.05	56.504	17.222	.01770	58.065	-1.4513925	-4.6417453	36	23	24
7	.7	.0276	.3848	.00060	3.4251	2.2990	.29196	434.97	41.514	12.653	.02409	70.032	-1.5852859	-4.7756673	49	21	22
8	.8	.0315	.5027	.00078	4.4736	3.0028	.22353	333.03	31.784	9.6875	.03146	103.22	-1.7012699	-4.8916227	64	20	21
9	.9	.0354	.6362	.00099	5.6619	3.8004	.17662	263.13	25.113	7.6191	.03982	131.25	-1.8035749	-4.9939083	81	19	20
10	1.0	.0394	.7854	.00122	6.9900	4.6918	.14306	213.14	20.342	6.2000	.04916	161.29	-1.8950899	-3.0854427	100	18	19
11	1.1	.0433	.9503	.00147	8.4580	5.6771	.11823	176.15	16.811	5.1240	.05551	195.16	-1.9778753	-3.1682281	121	17	19
12	1.2	.0472	1.1310	.00175	10.066	6.7562	.099348	148.01	14.126	4.3055	.07079	232.26	0.0534525	-3.2438051	144	17	18
13	1.3	.0512	1.3273	.00206	11.813	7.9292	.084651	126.11	12.036	3.6687	.08308	272.58	0.1229767	-3.3133297	169	16	18
14	1.4	.0551	1.5394	.00239	13.700	9.1960	.072990	108.74	10.378	3.1633	.09635	316.13	0.1873459	-3.3776991	196	15	17
15	1.5	.0591	1.7671	.00274	15.728	10.557	.063582	94.727	9.0407	2.7556	.11061	362.90	0.2472725	-3.4376385	225	15	17
16	1.6	.0630	2.0106	.00312	17.895	12.011	.055883	83.257	7.9460	2.4219	.12585	412.90	0.3033299	-3.4936827	256	14	16
17	1.7	.0669	2.2698	.00352	20.201	13.559	.049502	75.580	7.0386	2.1454	.14207	466.13	0.3559877	-3.5463405	289	14	16
18	1.8	.0709	2.5447	.00394	22.648	15.201	.044155	65.783	6.2783	1.9136	.15928	522.58	0.4056349	-3.5959877	324	13	15
19	1.9	.0748	2.8353	.00439	25.234	16.937	.039629	59.041	5.6348	1.7143	.17747	583.32	0.4525971	-3.6429615	361	13	15
20	2.0	.0787	3.1416	.00487	27.960	18.767	.035765	53.284	5.0854	1.5500	.19664	645.16	0.4971499	-3.6875027	400	12	14
21	2.1	.0827	3.4636	.00537	30.826	20.691	.032440	48.330	4.6126	1.4059	.21680	711.29	0.5395285	-3.7298815	441	12	14
22	2.2	.0866	3.8013	.00589	33.832	22.708	.029558	44.037	4.2028	1.2810	.23794	780.65	0.5799353	-3.7702881	484	11	14
23	2.3	.0906	4.1548	.00644	36.977	24.820	.027044	40.291	3.8453	1.1720	.26006	853.23	0.6185455	-3.8089073	529	11	13
24	2.4	.0945	4.5239	.00701	40.263	27.025	.024837	37.003	3.5315	1.0764	.28316	929.03	0.6555123	-3.8458053	576	11	13
25	2.5	.0984	4.9087	.00761	43.688	29.324	.022890	34.102	3.2547	.99200	.30725	1008.1	0.6909699	-3.8813229	625	10	12
26	2.6	.1024	5.3093	.00823	47.253	31.717	.021163	31.529	3.0091	.91716	.33232	1090.3	0.7250367	-3.9153895	676	10	12
27	2.7	.1063	5.7256	.00875	50.957	34.203	.019624	29.237	2.7904	.85048	.35838	1176.6	0.7578175	-3.9481705	729	10	12
28	2.8	.1102	6.1575	.00954	54.802	36.784	.018248	27.186	2.5946	.79082	.38542	1294.0	0.7894059	-3.9797589	784	9	12
29	2.9	.1142	6.6052	.01024	58.786	39.458	.017011	25.343	2.4188	.73722	.41344	1356.5	0.8198859	-2.0102387	841	9	12
30	3.0	.1181	7.0686	.01096	62.910	42.129	.015896	23.682	2.2550	.68730	.44346	1453.3	0.8493325	-2.0396853	900	9	11
31	3.1	.1220	7.5477	.01171	67.174	45.088	.014887	22.179	2.1167	.64516	.47243	1550.0	0.8778133	-2.0681633	961	8	11
32	3.2	.1260	8.0425	.01247	71.578	48.044	.013971	20.814	1.9865	.60547	.50340	1651.2	0.9053899	-2.0957427	1024	8	11
33	3.3	.1299	8.5530	.01326	76.122	51.094	.013137	19.572	1.8679	.56933	.53535	1756.5	0.9321177	-2.1224707	1089	8	10
34	3.4	.1339	9.0792	.01407	80.805	54.237	.012375	18.437	1.7597	.53633	.56829	1868.8	0.9580477	-2.1484007	1156	8	10
35	3.5	.1378	9.6211	.01491	85.628	57.475	.011678	17.399	1.6605	.50612	.60221	1975.8	0.9832259	-2.1735789	1225	7	10
36	3.6	.1418	10.1788	.01578	90.591	60.806	.011039	16.446	1.5696	.47620	.63712	2100.0	1.0076949	-2.1980479	1296	7	10
37	3.7	.1457	10.7521	.01667	95.694	64.231	.010451	15.569	1.4859	.45282	.67305	2208.1	1.0314948	-2.2218478	1369	7	9
38	3.8	.1496	11.3412	.01758	100.94	67.750	.009907	14.760	1.4087	.42936	.70987	2329.0	1.0546571	-2.2450101	1444	7	9
39	3.9	.1535	11.9459	.01852	106.32	71.363	.009406	14.013	1.3374	.40763	.74773	2453.2	1.0772191	-2.2675721	1521	6	9

ing resolutions something like the following, which I will submit as a substitute for that just offered:

"*Resolved*, That the report of the wire gauge committee be accepted, it being understood by accepting it that we, as an association, commit ourselves to the following:

"First—That in reports, communications, and so forth, we will designate wires by their diameter expressed in fractions of the metre.

"Second—In our personal conversation and in business we will designate wires in the same way so far as that is possible.

"Third—This association will offer to wire manufacturers such aid in the way of information as shall enable them to intelligently list their wires by the metric system."

After some discussion, which followed much the same lines as that of Monday's session, the motion of Mr. Mason was lost and that of Mr. Phelps adopted.

Mr. DUNCAN then moved that the convention finally adjourn at 5 P. M., and on motion of Mr. De Camp, the secretary was directed to draw upon the funds of the association to the amount of fifty dollars for his expenses in attending the convention, and the bill was passed for sixty dollars for printing the table prepared by the committee appointed to report on wire gauge.

THURSDAY AFTERNOON SESSION.

The association was called to order at 2:30 P. M, the president in the chair.

Mr. LEGGETT: I would like to call attention to a matter of great importance to many of us, and probably to all, the undergrounding of wires. I would like it to be understood that after the reading of the last paper we will take up that matter for discussion.

Mr. C. O. Mailloux, of New York, read the following paper on Storage Batteries:

THE PRESENT STATUS OF THE STORAGE BATTERY.

In one of his masterly newspaper interviews,' a well

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known American electrician once said of the storage battery that it was chiefly remarkable for its power of stimulating the propensity for lying which is inherent in some natures. This sweeping assertion naturally makes me realize very fully the possible risk of compromising my reputation which I run in undertaking to make a few observations relative to the storage battery.

Under the circumstances an apology might seem to you to be a suitable preface, but I trust that a simple explanation will suffice to dispel all doubts on your part as to my good faith in the premises. This explanation rests upon the fact that the storage battery, like the dynamo, the arc lamp, the incandescent lamp, and many another thing, has grown and progressed. Only a year ago I would have hesitated, perhaps refused, to say anything before you in favor of the storage battery. My reason would not have been a lack of confidence, but rather a feeling that the era of the storage battery was not yet at hand. I felt that this youthful offspring of the great and powerful family of electrical applications promised to play as important an industrial rôle as any of its colleagues, but I also knew that it had already made one début some years ago and failed to draw, because it was too young. I would have been sorry to see its chances of success forever spoiled by a second premature attempt. The child seems, however, to have now had sufficient time to mature and perfect its training, and after an interval of some five years it has reappeared upon the scene, this time with a fair and encouraging success. Within a few months there has been in America a great revival of interest in the storage battery, as you are aware. Many of us practical men, who were once disposed to be sceptical, begin to regain confidence. Certainly the applications which have been made of the storage battery in this brief period prove beyond dispute that this time the storage battery is coming to stay. In some cases it found a new and profitable field waiting for it, as for instance in railroad car lighting. In many other cases it opened an entirely new range of possibilities by its playing a secondary rôle. In a word, it has a wide sphere of usefulness to cover, through many devious paths, some of which it alone can tread over, and many of which it will compass with the help of other applications of electricity. It does not presume to fill all these parts at once. In the case of some of them it may prove wise to permit the process of evolution to go on for some time to come, before they are considered.

It is not necessary, however, for the storage battery to wait until it can accomplish *everything* before accomplishing *something*. There are many applications where it is now entirely competent to give satisfactory results; and while doing what it is at present capable of, it can learn what it does not know. The dynamo was not at first what it is now, nor was the lamp, nor indeed were the details of lighting systems. Electric lighting was limited at first to isolated installations. The range of adaptability, compared with what it now is, was limited greatly. It was necessary to confine the applications of the light to isolated cases of fitness, since the apparatus was too limited in every respect to admit of doing more. But while we were doing what lighting could be done with these facilities—and making money too, even then—we were learning to do more. Invention, and the yet greater force, evolution, were hard at work to give us better ideas and more practical devices. In time came the central station, such as it was—and I might emphasize the *such*. Many are here present, doubtless, who were operating these pioneer arc light stations, with long rows of dummy lamps, to be shifted in or out of circuit for the purpose of balancing the work in the circuit itself. Then came the current regulator, and, following in its wake, a succession of devices and improvements, of methods, of systems. The evolution of the incandescent light is also of equal interest, and from the useless platinum wire lamp to the very useful alternating system of to-day, the steps are so numerous and strange that the mind finds itself in a regular museum in attempting to retrace them. I need not tell you that the evolution of the electric light is not complete. The very existence of our organization proves that, since our object is to promote and further the process of development. Each year we have found electric lighting advancing a few steps. Ten years from to-day we may have made so many of these steps that our present systems may seem obsolete, yet these very systems in their time were good enough to earn dividends with. This is precisely the case with the storage battery. Its application can even now play a brilliant part in electric lighting, but it can be very useful even if intrusted with a more modest part. In a word, it has arrived at that age and condition of development which fit it to enter the active service of civilization and begin the race for promotion. If I may judge by the very favorable attention which the storage battery has received from the public, and particularly from those who are dispensing electricity to the public, I think I can venture, like our very genial friend and learned colleague, Dr. O. A. Moses, to prophesy that the storage battery is going to be the next great step of progress. It has already taken its place in line, and I believe it will speak for itself inside of a year.

With regard to the storage battery itself, it may be said that in following its development since the days of Planté one meets with an already large and interesting collection of ideas and devices. It is outside of the scope of the present paper to enter into the study of the steps by which the art has arrived at the present stage. The number of patents relating to storage batteries in this country and in Europe is already quite large; nevertheless the number of good storage batteries is exceedingly small. In this respect history repeats itself. The large and constantly increasing number of patents on dynamos, lamps, regulators, converters and what not, when contrasted with the small number of those inventions which are really useful, suggests that a large proportion of inventors must have been engaged too deeply in taking out patents, and pay altogether too little attention to the work of reducing their inventions to practice. Passing by the history of the secondary battery and the theories of its action, which properly have no place in a paper like this, it might be of interest to dwell briefly on the objections urged against the storage battery. The two chief objections are limited life or durability and low economy. I shall frankly admit at the start that in many cases these objections are sufficiently valid to throw the storage battery out of competition. The final commercial test of the storage battery, however, is the prospect of gain which it offers under the circumstances of any given case. Viewed in this light, the above objections to the storage battery lose some of their force. I can cite as an example the case of a Philadelphia hotel which it is proposed to light by electricity. A practical electric light man who has been engaged in the business of establishing and operating central station plants ever since the beginning of electric lighting, went over the case very carefully and came to the conclusion that the storage battery would be preferable. So well satisfied is he of the fitness of the storage battery that he submitted detailed propositions for furnishing light. The present cost of lighting the hotel by gas is $7,500 per annum. For the sum of $6,500 per annum, this practical man is willing to assume the responsibility of furnishing light for a term of years. Being a careful and shrewd business man he has made a wide allowance in his calculation. He does not count upon the two years' guaranteed life of the battery plates, but assumes a necessity for their entire renewal in one year. He calculates, nevertheless, to make 15 per cent. on his investment, and I may say that he seldom makes mistakes in his ventures. In this case, the fact that light must be on "tap" for every moment of the 24 hours becomes an important consideration, and the evident advantages of the storage battery outweigh the questions of durability and economy. Now, taking up the question of durability by itself, I may say that it is greatly dependent not only upon the kind of battery, but even upon the use to which it is put.

Then perhaps he may neglect to put in more than the quantity necessary for a normal capacity. The result is that the battery is not fully charged, and to furnish the usual capacity it must be discharged by drawing upon its residual charge. He soon finds his battery giving symptoms of disease, and in a short time both the positive and negative plates will require doctoring, instead of one kind only.

It must be said, however, that improper care is not solely responsible for all the troubles that affect the life of the storage battery. Some difficulties, like the scaling off of the active matter, the buckling and stretching of plates, are largely inherent in the battery. They are natural consequences of the manner or method of making the battery. So it may be said that here the storage battery has a personal equation depending on the make, the care, skill and knowledge of the maker. This amounts to saying that some kinds of storage battery are more troublesome to keep in order than others.

The life of the storage battery plate must not be regarded as doomed to remain compassed within the term of a couple or three years. The limit is gradually being extended, and it may be said that each succeeding batch of the product of a factory is slightly better than the preceding. The same may be said of the cost, which, of course, is an important consideration, in view of the necessity for repairs or perhaps renewals at certain intervals. The cost of manufacture has been reduced 30 per cent. inside of one year, and it is even expected that it will be brought down to 50 per cent. before the year is up. The prices have not been reduced because the demand is great even as it is. This of itself shows that the storage battery has already a good field of usefulness, where it can command to a great extent its own price.

The weight of the battery is another of the objections to be met, particularly for street cars, etc. This objection is one which is of particular rather than of general application. It depends on the battery. We know, however practically, that with 27 lbs. of active matter, it is possible to provide a supply of energy for 6 lamp-hours, or over 10 watt hours per pound of matter. This result will no doubt be improved upon greatly.

Last but not least among the objections used against the storage battery is that of reduced economy. My esteemed friend and colleague, Mr. Anthony Reckenzaun, whom you will have the honor of hearing after me, will give you very clear and precise information on this question of economy, more practically as regards the use of storage batteries for power. I will leave this portion of the subject to him because I know he is a most competent authority. I will permit myself also to commend his very intelligent work in Europe during the last five years, in the application of accumulators to electrical traction and propulsion.

The question of economy considered in relation to the storage battery does not present such difficulties as might at first be supposed. Considered as an apparatus for transforming energy for electric lighting by incandescence, the storage battery has an efficiency so much below that of the dynamo, or the transformer, that it cannot hope to enter into direct competition with these in many cases. Of the electrical energy produced by the charging dynamo, probably not more than from 65 to 70 per cent. finds its way into the lamps. With direct lighting, as we know, we may obtain as much as 90 per cent. But just here there is a question of great interest and importance which arises, namely: the proportion of energy appearing in the lamp as light. In an incandescent lamp probably not five per cent. of the energy expended is utilized as light. This five per cent. of rays represents the proportion of heat rays which are visible. The other rays are invisible. Now it is also well known that this very proportion of the useful light-giving heat increases with the absolute temperature of the filament. This means that the higher we raise the incandescence of the filament, the more light it gives for a given amount of electrical energy. But when the filament is brought to an excessive temperature its life is not so great. Just here I will note the fact stated by authorities, that alternating currents have been found to increase the life of the filament as compared with continuous current. Now I can supplement this with the statement that the storage battery current gives yet much longer life to the lamp. It permits the raising of the filament to a higher degree of temperature, and consequently it leads to a gain in the energy required.

We have found in practice that we can obtain the same average life of 600 hours with a lamp of 2½ watts per candle-power, while direct currents would require lamps of 3½ to 4 watts per c. p. In our early work, realizing the great disadvantage at which we are placed, we resorted to the use of lamps of higher economy, so called. The makers of these lamps refused absolutely to give any kind of life guarantee. They were themselves yet more surprised than we to learn of the remarkably long endurance of these lamps, even on board cars, where the filament is subjected to the wearing effect of mechanical vibration.

Of course I cannot pretend to say what is the cause of this increased life of lamps with the storage battery current. It is probably related in some manner to the fact that the current of a storage battery is continuous in the strict sense of the term, while the current of dynamos and transformers is wavy in character.

It would seem, therefore, that so far as electric lighting by incandescence is concerned, while the storage battery is open to the objection of wasting at the spigot, it can claim some saving at the bung-hole, which quite nearly equalizes the difference between the results obtained by the direct and the storage method. Taking our 65 per cent. of energy, or in round numbers 485 watts, we can obtain twelve lights per electrical horse-power of 746 watts produced in the dynamo, using lamps of 51 watts, which is the most economical yet heard of with a continuous current, we have the following results: Out of 746 watts, taking 90 per cent. as available at the lamps, which is a liberal proportion, we have 671 watts, or less than 12 lamps of 51 watts. If we consider the fact that in practice, lamps of 60 to 70 watts per 16 candle-power are the rule, the difference would be yet greater in favor of the storage battery. Taking another view of the question, we can calculate what is the lowest per cent. of efficiency permissible in the storage battery.

Taking 11 lamps as the result of the direct application from the dynamo, we find that the storage battery must, at 40 watts per lamp, supply 440 watt hours out of each 746 watt hours given to it, or somewhat less than 59 per cent.

I need not dwell at length upon the uses of the storage battery and the services which it can render in connection with electric light plants, for these are quite generally understood, and new ones suggest themselves all the time. The present rate of demand shows that the uses are at least equal to the rate of supply and sometimes in excess. One application of special interest in this connection, however, is that in connection with incandescent lighting, both from isolated and central station plants, the incandescent light is growing in favor so rapidly that where it is already in use for a certain number of hours during the evening, there is an objection to the use of gas at other times. In small installations it would not evidently pay to run constantly for a few lights. The storage battery would here be very useful, if not indispensable, and a number of local companies who could sell electricity for power in limited amount are also turning to the storage battery. Since they are compelled to run during the day to supply electricity for a few lamps and motors they find it would be as well to run to full capacity, using the balance of power to charge storage batteries from which the energy can be drawn later in the evening, to supply incandescent lamps.

In conclusion, I hope I have succeeded in making a fair presentation of the storage battery case, so far as it concerns the uses and purposes of electric light men. As I have intimated, the storage battery is as far from being perfect as were the first dynamos with which some of the enterprising men of this very body first paved the way to the great industry that now interests so many minds and enlists so much capital. But it is so far perfect, however, that it is ready to help enlarge this great industry to push further ahead in its wonderful development.

On motion of Mr. T. C. Martin the discussion of Mr. Mailloux's paper was made a joint one with that of Mr. A. Reckenzaun, who read the following paper on

STORAGE BATTERIES FOR ELECTRIC LOCOMOTION.

The idea of employing secondary batteries for propelling vehicles is almost contemporaneous with the discovery of this method of storing energy. To Mr. Planté, more than to any other investigator, much of our knowledge in this branch of electrical science is due. He was the first to take advantage of the action of secondary currents in voltaic batteries. Planté is a scientist of the first grade, and he is a wonderfully exact experimenter. He examined the whole question of polarization of electrodes, using all kinds of metal as electrodes and many different liquids as electrolytes, and during his endless researches he found that the greatest useful effect was produced when dilute sulphuric acid was electrolyzed between electrodes of metallic lead.

A set of Planté's original cells was exhibited for the first time, in March, 1860, before the Paris Academy of Sciences; scientists admired and praised it, but the general public knew nothing of this great discovery, thus brought to notice. Indeed, at that period little commercial value could be attached to such apparatus, since the accumulator had to be charged by means of primary batteries, and it was then well known that electrical energy, when produced by chemical means in voltaic cells, was far too expensive for any purpose outside the physical laboratory or the telegraph office.

It was twenty years after this exhibition at the Academy of Sciences in Paris, that public attention was drawn to the importance of storage batteries, and that Mr. Faure conceived the idea of constructing plates, consisting of lead and oxides of lead. At that time the advantages accruing through a system of electrical storage could be fully appreciated, since electrical energy was already being produced by mechanical means through the medium of dynamo electric machines.

It was the dynamo machine which created the demand for the storage battery, and the latter was introduced anew to the public at large and to the capitalist with great pomp and enthusiasm. One of Faure's accumulators was sent to Sir William Thomson, and this eminent scientist in the course of experiments ascertained that a single cell, weighing 165 lbs., can store two million foot-pounds of energy, or one horse-power for one hour, and that the loss of energy in charging did not exceed 15 per cent. These results appeared highly encouraging. There we had a method of storing that could give out the greater part of the energy put in. The immense development which the electric transmission of energy was even at that early day expected to undergo pointed to the fact that a convenient method of receiving large quantities of transmitted energy, and of holding it in readiness until wanted, must be of the highest importance. Numerous applications of the Faure battery were at once suggested, and the public jumped to the conclusion that a thing for which so many uses could be instantly found must necessarily be a profitable investment, and plenty of money was provided forthwith, not with the idea of commencing careful experiments and developing the then crude invention, which would have been the correct thing, but for manufacturing tons of accumulators in their first and immature form.

I need not describe the disappointments which followed the first unfulfilled hopes, nor repeat the criticism that was heaped upon the heads of the early promoters. Those early hopes were untimely and unreasonable. A thousand difficulties had to be overcome—scientific difficulties and manufacturing difficulties. This invention, like most others, had to go through steady historical developments and evolution, and follow the recognized laws of nature, which are against abnormal and instantaneous maturity. The period of maturity has also been retarded by inju-

dicious treatment, but the ultimate success was inevitable. Great advances have been made within the last few years, and I propose now to offer a few facts and figures relating to the present state of the subject with reference to the application of storage batteries to locomotive purposes. It is not within the province of this paper to discuss all the different inventions of secondary batteries nor to offer any suggestions with regard to priority. therefore I will confine myself to general statements. I am aware of the good work that was done in the United States by Kirchhof 26 years ago, and of the more recent work of Mr. Brush, of Cleveland, Mr. Julien and others, but I am more particularly acquainted with the recent achievements of the Electrical Accumulator Company, who own the rights of the Electrical Power Storage Company, of London. I have used the batteries of the latter company for propelling electric boats and electric street cars. The first of the boats was the "Electricity," which was launched in September, 1882, and which attained a speed of seven miles an hour for six consecutive hours. Since then a dozen electric boats of various sizes have been fitted up and worked successfully by means of storage batteries and motors of my design. The most important of these were the launch "Volta," and another similar craft, which is used by the Italian Government for torpedo work in the harbor of Spezzia. On the measured mile trial trips the Italian launch gave an average speed of 8.43 miles an hour with and against the tide. The hull of this vessel was built by Messrs. Yarrow & Co., and the motors were manufactured by Messrs. Stephens, Smith & Co., of London. The "Volta," which was entirely fitted by the latter firm, is 37 feet long and 7 feet beam. She draws 2' 6" of water when carrying 40 persons, for whom there is ample sitting accommodation. There are 64 cells in this boat; these are placed as ballast under the floor, and actuate a pair of motors and a screw coupled direct to the armature shaft running at 700 revolutions a minute. We crossed the English channel with this boat in September of last year, leaving Dover at 10:40 in the morning, arriving at Calais at 2:30 P. M.; stayed about an hour in the French harbor for luncheon and floated into Dover docks the same evening, at 6:30 with full speed. The actual distance traversed without entirely discharging the cells was 54 miles, the current remained constant at 28 ampères until 5 P. M., and it only dropped to 25 ampères at the completion of the double voyage between England and France. Several electric launches are now being constructed in London, and one in New York by the Electrical Accumulator Company.

M. Trouvé exhibited a small boat and a tricycle, both worked by Planté accumulators, at Paris, in 1881.

The first locomotive actuated by storage batteries was used at a bleaching works in France in 1882. During the same year I designed an electric street car for the Storage Company, and this was tried on the lines of the West Metropolitan Tramways in March, 1883. It had accommodation for 46 passengers. This car had many defects, and I reconstructed it entirely, and ran it afterwards in its improved form on the South London Tramways, and also on a private track at Millwall, where it is now in good condition, and I have a similar car in Berlin. M. Phillippart exhibited a car in Paris and M. Julien made successful experiments in Brussels, Antwerp and Hamburg. Mr. Elieson is running storage battery locomotives in London. Mr. Julien has also been experimenting with a car in New York, and I believe one is in course of construction for a line in the city of Boston. Messrs W. Wharton, Jr. & Co. have a storage battery car running at Philadelphia on Spruce and Pine streets, and this energetic firm is now fitting up another car with two trucks, each carrying an independent motor, similar to my European cars.

I have mentioned all these facts in order to show that there is a considerable amount of activity displayed in the matter of storage batteries for street cars, and that continued and substantial progress is being made in each successive case. The prejudices against the application of secondary batteries are being rapidly dispelled, and there are indications everywhere that this method of propulsion will soon take a recognized place among the great transit facilities in the United States. I feel convinced that this country will also in this respect be far ahead of Europe before another year has passed over our heads.

There are several popular, and I may say, serious objections to the employment of storage batteries for propelling street cars; these objections I will now enumerate and endeavor to show how far they are true, and in what measure they interfere with the economical side of the question.

First objection: The loss of energy, which amounts in practice to 20, and sometimes 30 per cent. Now, every method of storing or transmitting energy involves some waste, but in saying this we need not condemn the system, for after all the term efficiency is only a relative one. For instance, a 10 horse power steam engine consumes three times as much fuel per horse-power hour as a 1,000 horse-power engine does, yet this small engine must be, and is regarded as, one of the most economical labor saving appliances known to us. Considered as a heat engine the efficiency of the most economical steam motor is but 10 per cent.—90 per cent. of the available units of heat contained in coal being lost during its transformation into mechanical energy. Thus, if we find that the storage battery does not return more than 70 per cent. of the work expended in charging it, we ought not to condemn it on that account until we have ascertained whether this low efficiency renders the system unfit for any or all commercial purposes. It is needless to go into figures in order to show that, when compared with animal power, this objection drops into insignificance.

The second, more formidable objection, relates to the weight of storage batteries—and this involves two disadvantages, viz.—waste of power in propelling the accumulator along with the car, and increased pressure upon the street rails, which are only fitted to carry a maximum of 5 tons distributed over 4 points, so that each wheel of an ordinary car produces a pressure of 1¼ tons upon a point of the rail immediately under it.

The last mentioned objection is easily overcome by distributing the weight of the car with its electrical apparatus over 8 wheels or 2 small trucks, whereby the pressure per unit of section on the rails is reduced to a minimum. With regard to the weight of the storage batteries, relatively to the amount of energy the same are capable of holding and transmitting, I beg to offer a few practical figures. Theoretically, the energy manifested in the separation of one pound of lead from its oxide is equivalent to 360,000 foot pounds, but these chemical equivalents, though interesting in themseves, give us no tangible idea of the actual capacity of a battery.

Repeated experiments have shown me that the capacity of a secondary battery cell varies with the rate at which it is charged and discharged. For instance, a cell such as we use on street cars gave a useful capacity of 137.3 ampère hours when discharged at the average rate of 45.76 ampères, and this same cell yielded 156.38 ampère hours when worked at the rate of 22.34 ampères. At the commencement of the discharge the E.M.F. of the battery was 2.1 volts and this was allowed to drop to 1.57 volts when the experiment was concluded. The entire active material contained in the plates of one cell weighed 11.5 lbs., therefore the energy given off per pound of active substance at the above high rate of discharge was 62,225 foot pounds, and when discharging at the lower rate of 22.34 ampères the available useful energy was 72,313 foot pounds, or nearly 2.2 electrical horse-power per pound of active matter. But this active substance has to be supported, and the strength or weight of the support has to be made sufficiently great to give the plate a definite strength and durability. The support of the plates inclusive of the terminals above referred to weighs more than the active material, which consists of peroxide of lead and spongy lead; so that the plates of one cell weigh actually 26.5 pounds; add to this the weight of the receptacle and acid, and you get a total of about 41 pounds per cell when in working order. Seventy of these cells will propel an ordinary street car for four hours and a half, while consuming the stored energy at the rate of 30 ampères, or over 5.6 electrical horse-power. The whole set of seventy cells weighs 2,870 lbs., which is barely one-fifth of the entire weight of the car when it carries forty adult passengers, therefore the energy wasted in propelling the accumulator along with a car does not amount to more than 20 per cent. of the total power, and this we can easily afford to lose so long as animal power is our only competitor. From numerous and exhaustive tests with accumulators on cars in this country and abroad, I have come to the conclusion that the motive power for hauling a full sized street car for fifteen hours a day does not exceed $1.75, and this includes fuel, water, oil, attendance, and repairs to engine, boiler and dynamo. We have thus an immense margin left between the cost of electric traction and horse traction, and the last objection, that relating to the depreciation of the battery plates, can be most liberally met, and yet leave ample profits over the old method of propulsion by means of animals.

The advantages of storage battery street cars for city traffic are self-evident, so that I need not trouble you with further details in this respect, but I would beg those who take an interest in the progress of the electric locomotive to give this subject all the consideration it deserves, and I would assure them that the system which I have advocated in this brief but every incomplete sketch is worthy of an extended trial, and ready for the purposes set forth. There is no reason why those connected with electric lighting interests in the various cities and towns should not give the matter their special attention, as they are the best informed on electrical engineering and already have a local control of the supply of current needed for charging.

Mr. RECKENZAUN: I hope you will do me the honor to discuss this subject as thoroughly as our time will permit, and raise as many difficulties and objections as you possibly can, and I shall do my best to answer them. (Applause.)

Dr. MOSES: There is a question I would like to ask which is important in its bearing on the running of street cars. Will Mr. Reckenzaun give us the weight in pounds of the car that he speaks of in Philadelphia and which he wants us to go and ride upon?

Mr. RECKENZAUN: I have given the weight of the batteries in this paper. In the car which we use in Philadelphia there are actually 80 cells, because there are considerable gradients to go over. Each cell weighs 40 pounds and the average horse-power of each battery is six. Sometimes we only use two horse-power and sometimes, going up grades of 5 per cent., we use as much as 12 horse-power, but the average rate is 6 electrical horse-power. With reference to the weight of passengers on the cars, we have never carried more than 50 passengers on that car, because it is impossible to put more than 50 men into it. There are seats for 24 and the rest have to stand on the platforms or in the aisle.

Dr. MOSES: Another question, if you please. What time does it take you to change your battery?

Mr. RECKENZAUN: The changing of the batteries takes three minutes with proper appliances. One set of cells is drawn out by means of a small winch and a freshly charged set is put in. It takes the same time to charge the battery as it does to discharge it in the working of the cars, so one reserve set would be sufficient to keep the car continually moving.

Dr. MOSES: What is the loss of energy per diem by allowing the batteries to remain unused?

Mr. RECKENZAUN: The loss of energy from standing about is probably nothing. If a battery were to stand charged for three months in a dry case the loss of energy might be in three months 10 per cent. I purposely had a set of cells standing for two years charged and never used them. After two years there was still a small amount of energy left. So as regards the loss of energy in a battery standing idle, it is practically nothing, because no one would think of charging a battery and letting it stand for three months or a year.

Dr. MOSES: That result is exceedingly interesting, because it suggests something that was done by Faraday in determining the length of time that would elapse before a vacuum would be absolutely destroyed. It was there determined that it would take about one year for a Torricellian vacuum to disappear; so we have this action really verifying that. It is possible to keep it charged in that way for two years, you say, and still allow of some residual charge.

Mr. RECKENZAUN: There was a small amount of energy left. There was still electrical energy left after two years. I have had them stand three or four months and I could hardly appreciate the loss going on, providing always that the cells are standing on a dry floor. If the exterior of the box be moist, or if it stands on a moist floor, there will naturally be a surface leakage going on; but where there is no surface leakage the mere local action between the oxides and metallic lead will not discharge the battery for a very considerable time.

Mr. POWERS: There is one important matter, the amount of power used. When it requires from 4 to 12 horse-power to accomplish the work, I would like to know where the loss occurs. If the energy of the street car horse is good for 2 to 6 horse-power. I think I shall have a great deal more respect for the horse than I have had before.

Mr. RECKENZAUN: I have made experiments in London with a loaded car pulled by two horses. I put a dynamometer between the attachment of the horse and the car, so as to ascertain exactly the amount of pull, measured in pounds multiplied by the distance traversed in a minute. You will be surprised to know that two horses, when doing their easiest work, drawing a loaded car on a perfectly level road, exert from two to three horse-power. I have mentioned a car in Philadelphia where we use betwee two and twelve horse-power. A horse is capable of exertn ing eight horse-power for a few minutes, and when a car is being driven up grades, such as I see in Boston, for instance, pulling a load of passengers up these grades, the horses must be exerting from 12 to 16 horse-power, mechanical horse-power. That is the reason that street car horses cannot run more than three or four hours out of the 24. If they were to run longer they would be dead in a few weeks. If they run two hours a day they will last three or four years.

Mr. PHELPS: Are you prepared to give an estimate, approximately, as to the life of the cells? How long would it be before they would have to be entirely renewed?

Mr. RECKENZAUN: The life of the cells must be expressed upon the principle of ampère hours or the amount of energy given off by them. Street car service requires that the cells work their hardest for fifteen or sixteen hours a day. The life of the cells has to be divided; first, into the life of the box which contains the plates. This box, if appropriately constructed of the best materials, will last many years, because there is no actual wear on it. The life of the negative plates will be very considerable, because no chemical action is going on in the negative plate. The negative plate consists almost entirely of spongy lead, and the hydrogen is mechanically occluded in that spongy lead. Therefore the depreciation of the battery is almost entirely due to the oxidation of the positive plates. If we were to make a lead battery of plates ¼-inch thick, it would last many years; but for street car work that would be far too heavy. Therefore we make the positive plates a little more than one-eighth of an inch thick. I find that the plates get sufficiently brittle to almost fall to pieces after the car has run fifteen hours a day for six months. The plates then have to be renewed. But this renewal does not mean the throwing away of the plates. The weight is the same as before, because no consumption of material takes place. We take out peroxide of lead instead of red lead. That peroxide, if converted, produces 70 per cent. of metallic lead, so that there is a loss of 30 per cent. in value. Then comes the question of the manufacture of these positive plates, which, I believe, at the present day are rather expensive. But I believe the time will come when battery plates will be manufactured like shoe nails, and the process of renewing the positive plates will be a very cheap one.

Mr. MARTIN: How much is the expense for each car mile including depreciation?

Mr. RECKENZAUN: I ascertained in Europe that the motive power costs 2 cents per car mile; that is, the steam-power and attendance for charging the batteries. We have to allow twice as much for the depreciation of a battery at the present high rate at which we have to pay for the battery, $12 for each cell. But, I believe, that as soon as the storage battery industry is sufficiently extended, the total cost for propelling these cars will not be more than six cents a mile, or about one-half the cost of the cheapest horse traction.

Mr. MARTIN: I have listened to Mr. Reckenzaun's paper with a great deal of interest and attention, and was very glad to have the opportunity of gathering so much information in so short a time and presented so compactly. Mr. Reckenzaun has had a privilege which very few of us can enjoy, and that is of visiting every one of the electric railways in Europe now in operation. His very valuable observations on that subject were recently presented to the London Society of Arts, and presented in so able, masterly and exhaustive a manner as to obtain for Mr. Reckenzaun the silver medal of that society. (Applause.) I read Mr. Reckenzaun's paper brought before that society with a great deal of interest, but there was one point which impressed me very much, and that was that in Europe the merits, the claims and the advantages of the cable system did not seem to enter into the consideration of the case at all Here we have to deal with that problem. The cable is running in this country; it is running in most of our large cities where the storage battery must find its chief scope and play, and unless with the storage battery we can make a better presentation than the cable men make with the cable and the grip, it is not likely that we shall see the storage battery assume the position and importance which we believe it is entitled to. I have seen various statistics on the subject of the amount of power required for operating a cable railway, and I have seen some of the statements go as high as a loss or waste of 80 per cent. I would like to ask Mr Reckenzaun whether, since his arrival in this country, he has looked into that subject at all and whether he finds that the loss in getting the current into the storage battery and then delivering it to the motor is less in comparison than that in the use of the cable in the power finally delivered to the car.

Mr. RECKENZAUN: I have made some very careful observations on the cable tramway in Philadelphia, which is quite an extensive system. I have never been able to ascertain the exact amount of waste in pulling the cable itself; but I have it on the authority of certain technical papers that there is a waste of about eighty per cent. I do not intend to depreciate cable or any other tramways, but there is a difficulty about introducing cable tramways. It is necessary to dig up the streets and interfere with the roadways. I have been told that the cable arrangements in Philadelphia cost $100,000 a mile, and that the cable road in San Francisco cost more than that. One of the directors of the cable company in Philadelphia told me that if he had seen the battery system before the introduction of the cable he would probably have made up his mind in favor of the former. The wear and tear in the case of the storage system is also considerable. There is a waste of energy in the dynamo; secondly, in the accumulator charged by that dynamo; thirdly, in the motor which is driven by the accumulator, and fourthly, in the gearing which reduces the speed of the motor to the speed required by the car axles. It would be difficult to make a motor run at the rate of eighty revolutions per minute, which is the number of revolutions of the street car axle when running

at the rate of ten miles an hour. Take all these wastes and you find in practice that you do not utilize more than 40 per cent. of the energy given by the steam engine. But this is quite sufficient to make this system much cheaper than horse traction.

Mr. MANSFIELD: I would like to ask Mr. Reckenzaun in regard to the waste of energy necessary to carry the storage batteries. Would it not take as many batteries in some cases as to make their weight many times the weight of the car? On a level street it would not take so many. Batteries of two horse-power might be sufficient, but on a grade of five per cent. it would be necessary to carry twelve horse-power storage batteries for probably ninety per cent. of the time. Although I understand that the energy of these batteries would not be used except when needed, at the same time they would weigh a great deal when carrying them through the streets. I have figured somewhat on these problems, and I am still inclined to favor the more direct system, I believe that the time arrives in the history of a city when it is necessary that considerations of beauty should be sacrificed for utility. When necessity demands it we can run wires overhead through our streets, and in running the wires overhead you obviate a number of these lesser losses that Mr. Reckenzaun mentions. Then I would like to ask if he would give us any figures that he has in regard to the rate of loss that he would allow on an average load between the power necessary to the passengers themselves and that to propel the car?

Mr. RECKENZAUN: In my paper I gave the exact figures of the weights of the entire material used in propulsion and the weight of the car as a whole. I think I stated that the electrical apparatus has one-fifth of the weight of the car when filled with passengers. Then Mr. Mansfield says that we have to carry 12 horse-power batteries, because occasionally that power is required. Now, it is well known that we can discharge the storage battery *ad libitum*, at the rate of 2 ampères or 200 ampères. I can get out of a storage battery almost any horse-power I like for a short space of time. I have not the least objection to the direct system. But when you come to run twenty or thirty or fifty cars on one line, you will require very large conductors or dangerously high electromotive force. The overhead system is applicable to its own particular purposes. Where there are only five or ten, or even twenty cars, running on one line, and that line runs through a suburb or a part of a city where there are not many houses, that system is to be preferred. The objection to the overhead system is not so much the want of beauty, but the want of practicability. You have to put your posts very high indeed so as to let great wagon-loads of hay and all sorts of things pass underneath. Most of the trouble comes in winter, and when it is snowing hard a great many difficulties arise. As regards the loss, suppose that the resistance of the overhead lines is one ohm. To draw one car it will take an average of 20 ampères, and the only loss will be 20 multiplied by 20, that is 400 watts through line resistance. But if there are ten cars, on that line you get 40,000 watts loss of energy, unless you increase the conductor in proportion to the number of cars. If you do that you get an enormous conductor, and have a sort of elevated railroad instead of a telegraph wire, as most people imagine an overhead conductor to be.

Mr. RECKENZAUN said further in answer to a question put by Mr. Smith: The current required to run a street car is about thirty ampères, and an electromotive force of about 180 volts. If cars are run in connection with an incandescent light station, we can arrange our apparatus so that we can use an E. M. F. say of 110 volts, and then we can put in a smaller number of cells with a larger capacity that will give a corresponding horse-power. We can charge such larger cells with 50 or 60 ampères instead of thirty.

In regard to arc lighting machinery, the arc lighting dynamo should not be used to charge the accumulators. They can be used, but they require such constant attention as to make them impracticable. We can only use shunt-wound dynamos conveniently for that purpose.

Mr. PENDLETON: I understood that the loss of power in drawing the cables in Philadelphia was ascertained at 50 per cent. In San Francisco it was 68 per cent. used in drawing the cables, 28 per cent. in operating the cars and 4 per cent. in carrying passengers, In the remarks made by Mr. Reckenzaun I understood him to say that he considered the shunt-wound dynamo essential in charging the storage battery.

I have had in continual use a dynamo for the purpose of charging storage batteries, but I found it necessary to use a current breaker in order to avoid the reversal of the dynamo, which at one time bothered me a good deal. I think perhaps there is no other difficulty whatever in using any ordinary series dynamo, although the shunt-wound dynamo has certain advantages for general use.

I am reminded by hearing Mr. Mansfield speak of the direct system of transmission, that about a year ago I was asked the question by the board of directors of the Brooklyn City Railway, what the difference in cost was between the direct transmission of electricity for the purpose of propelling cars and the storage battery. It was a complex question, and I felt that it could be solved by a diagram more readily than by language. Therefore, I drew two parallel lines of rails, supposed to be five miles in extent, and I pointed out that the resistance of the circuit when it reached a sum to divide the power developed at the station would make the secondary battery beyond that the most economical. On one occasion, before the New York Electrical Society, where we were debating the subject, I mentioned a method which I had of using direct transmission near the station, charging the batteries and operating the motor by means of a combination of the battery, and then utilizing the electrical energy at the extreme ends of the route. A storage battery might be able to work far more usefully than by merely exhausting a charged cell. I believe that, under the circumstances, a secondary battery can be made to operate a car for a day of fifteen hours without removal, and only require to be removed when, by extra discharges, the motor became heated or required attention in the battery hospital, which every car station must have.

Mr. MAILLOUX: I might say that I am myself largely interested in the problem of street car traction with accumulators, inasmuch as I happen to be consulting electrician for the company which I believe put the first street car propelled by accumulators into commission – a car run on the Madison and Fourth avenue lines in New York City. Some of the data which I add by way of corroboration or comparison with those of my friend Mr. Reckenzaun might, perhaps, be interesting. The grades on that line, as some of you may know, are extremely severe; not only that, but they are long, so that they tax not only the capacity of the motor, but that of the battery very severely. We have on one part of the line a grade of nearly 5½ per cent., and there are a number of grades as high as 4 per cent. Besides that, in several places the grades happen to be on curves, which add greatly to the effort required by the motor to propel the car. We have found that it was preferable to use two motors instead of one. We think it would be better to use motors rather larger than necessary in order to obtain larger efforts with a comparatively high efficiency. We use 130 cells, which weigh somewhere in the neighborhood of 3,000 pounds. The whole car, with the motor and batteries, weighs as nearly as possible about six tons without passengers. This weight is altogether excessive, for the reason that the car has very strong iron beams. It was strengthened in Europe before it was sent over here, with the idea that we might want to carry enormous weights upon it.

One of the other questions that I wished to ask Mr. Reckenzaun was as to the amount of electrical energy per mile, that he finds necessary. I have found as the result of repeated observations that we must count upon an electrical supply of energy equivalent to from one to one and two-tenths electrical horse-power per car mile. This means that if we have a supply of electrical energy equal to, say, 40 electrical horse-power hours, we have enough energy to run somewhere between 35 and 40 miles. In practice we do not deem it expedient to exhaust completely the capacity of the car, and we find that a run of 30 to 35 miles is all that it is best to make in the ordinary everyday work of a car. We find, therefore, that in the average day's run of 60 or 70 miles it is necessary to change the accumulators twice a day. The car would start with a charge in the morning and would change somewhere about the middle of its work, irrespective of the number of hours it had been in operation, because the number of hours run includes the stops. You will see, therefore, that the mere time necessary for changing the batteries becomes quite insignificant when there are only two sets of them to be changed in one day. So that I do not think the objection advanced by Mr. Pendleton has very much force, in this case at least.

The question of transmitting the power from the axle of the motor shaft to the wheel shaft is one that has received a great deal of attention. I know that Mr. Reckenzaun has gone over that subject very carefully in Europe, and that he has some original plans and systems of his own. I think it would be very interesting if he would tell us of his experience.

In one system we have found it preferable to use a counter shafting in order to reduce the speed of the motor, but the reduction which we obtain is perhaps larger than it would be in regular practice. We reduce in the ratio of nearly one in ten. In other words, the motor runs nearly ten times as fast as the shafting.

In considering the expediency of a change, it becomes an important question to determine how quickly and how rapidly that change shall be made. It is there that the secondary battery system presents undoubtedly great advantages. If this system is to be operated by any overhead conductor or underground conductor, it is necessary that we should go at once to the expense of organizing the system of conductors completely from one end to the other. We must provide facilities before we can run one car for establishing a circuit for as many conductors as may be necessary. It does not matter whether part of the system is operated by storage or part by horses, because they are independent of each other. The only thing that we have found in practice is that we have to be careful not to run into the other cars, because there is one point which you must bear in mind, which is this, that just the same as the electric light, when it first came, not only gave us cheaper light but gave us more of it, so the electric street car system not only gives us very good locomotion, but gives us very much better speed. Now, in the upper part of the road in which we have this system there is a suburban end which extends from Eighty-sixth street to Harlem. There are very severe grades there, but the patronage is not very large, and is more suburban than anything else. There they run some thirteen cars. Now, the superintendent of the road, with whom I happened to be on the car one day when they were making experiments, told me voluntarily that with the electrical storage system it would be possible to give the people in that neighborhood something very close to rapid transit. It would be possible to run all the cars at much faster rate of speed—it would be permissible, under certain conditions when it is remembered that the line is almost entirely in the suburbs of the city—and in that way the time of making the trip would be very much shortened. We found that we could very easily attain a speed of twelve miles an hour. Of course we are not at liberty to make very lengthy runs at that speed, but we have experimented with the line during the night several times, when the tracks were entirely free, and in that way we have been able to determine pretty accurately the rate of speed that might be maintained.

In regard to the charging of storage batteries by arc light circuits, there is perhaps some misapprehension in my friend's mind. I do not think that with small dynamos it would be possible to use them; but in speaking of charging storage batteries as we understand it, commercially, it would no doubt refer to a few storage cells of an arc light circuit. As the E. M. F. of the battery would be very much smaller in comparison with that kind of dynamo-electric machine, there would be no difficulty whatever. The only disadvantage is that of the low rate of current to which the arc light circuit has gradually been dwindling, and we find that in a great many cases it is not more than 6½ ampères. In that case it would take something like between 22 and 24 hours to effect a complete charge.

Now there is another important thing in relation to the electric railroad. It is the question of braking the momentum by electricity. I found that railroad men, as conservative as they are, when once they conclude to adopt electricity like to have everything done by electricity on the car; and one of the first questions which they propounded was as to the practicability of braking the momentum by electricity. I know of an electrician who proposed to use the motor in charging a battery while descending a grade, which would produce an intermittent charging. I confess that I do not see very much margin to be expected from this, judging from what has been developed up to the present time, in the way of economy or gain; but I should be interested in hearing the views of so experienced an electrician as Mr. Reckenzaun on that subject. With the car that we are running on Fourth avenue we were enabled to run up a high grade with a load of some thirty passengers, with an additional car attached containing some few passengers more. But the superintendent was not satisfied with that. He made a stop on the grade, and, after stopping, a start was accomplished without any difficulty.

Mr. RECKENZAUN: In regard to using two motors on a car, there are several advantages in it. I use two motors on all my cars in Europe, and always have done so from the beginning. One of the advantages is, that in case of an accident to one motor the other will bring the car home; secondly, with two motors we can vary the speed without changing the E.M.F. of the battery. If I want very much power I put two motors in parallel, getting four times the power that I do with one machine, and an intermediate power of two motors. There is another advantage of having two motors, and that is that we can use two driving axles instead of one, and we can go up grades with almost double the facility that way, because the adhesion would be double. These are the main advantages arising from the use of two or more motors. Mr. Mailloux asked if I would give my experience in regard to the mechanical transmission between the motor and the car axle. I have used almost everything that was known at the time, but in order to give you a full and detailed account of the various modes of transmission which I have used I should have to give you figures to bear out certain experiments. I should only be able to do that in a lecture of at least five hours' duration, so I hope that you will kindly excuse me on that point.

With regard to the durability of plates, I have taken into consideration fifteen hours a day. In regard to the application of electrical brakes, I will say that that was one of the first ideas that entered my head when I began to use electric motors, and other people had that idea long before me. I have used an electric brake, using the motor itself as a brake—that is, as the car runs down a grade by momentum it generates a current, but this current cannot be used for recharging a battery. It is utter nonsense to talk about that unless we have a steady grade four or five miles long. The advantages are very small indeed, and the complications which would be introduced by employing automatic cut-outs, governors, and so on, would counterbalance anything that might be gained. As regards going up an incline, of course stopping and starting again has to be done often, and anybody who at any time works cars by electricity, whether they have storage batteries or not, has to allow for sufficient motive power to overcome all the difficultes that any line might present. One of the great mistakes which some of the pioneers in this direction made was that they did not put sufficient power upon the cars. You always ought to put on the cars power capable of exerting perhaps 20 to 40 per cent. more than is necessary in the ordinary street service, so that in case of the road being snowed up, or in the case of any other accident which is liable to occur, you ought to have plenty of power to get out of the scrape. Mr. Pendleton made certain suggestions in regard to a combined system of conductors and accumulators. I do not know much about those, and I could not give an opinion unless I had studied the matter thoroughly.

Mr. KINSMAN: What would be the effect on an accumulator of intermittent charges such as the gentleman spoke of in going down grades.

Mr. MAILLOUX: It would not have any bad effects so far as that is concerned. It is merely a question of the expediency of the process—whether there would be sufficient energy gained by it to make it worth while.

Mr. KINSMAN: The point I wanted to make was: Are intermittent charges economical and desirable?

Mr. MAILLOUX: I do not think it matters very much whether the current be intermittent or not. There may be a slight difference in fluctuation of the electromotive force by virtue of the variation of the rate of charge, and that might effect the efficiency of the storage battery as an instrument for conversion; but it would not affect its storing capacity to any appreciable extent.

Mr. MARTIN: I think we have all listened with pleasure to Mr. Reckenzaun's outlining of his experience. Mr. Reckenzaun is among us for a very short time. We have already in our ranks several distinguished European electricians as honorary members and I would like the opportunity of offering the resolution that we receive Mr. Reckenzaun into our ranks as an honorary member.

The PRESIDENT: Mr. Reckenzaun is already an active member. There is more honor in that than in being an honorary member.

Mr. RECKENZAUN: I can only express my feelings of gratitude for the honor conferred upon me. I am quite sure I do not deserve it.

The president then called on Mr. Duncan for his

REPORT ON ELECTRIC MOTORS.

Mr. DUNCAN: At the last meeting a committee was appointed to prepare statistics in regard to the number of motors in operation at central light stations, the prices paid, and so on. A circular was issued; some of the companies responded but a very large proportion did not respond. One member of the committee, however, in New York paid particular attention to the New England States and collected a large amount of valuable information which he promised to have with him here on Monday evening and to meet the other members of the committee. However, that information and the gentleman himself have not arrived and the papers which I have contain some information which I do not think should be published unless through the hands of the Executive Committee. It gives information regarding charges, etc., of some of the local companies which it might not be judicious to spread out for general information, and, therefore, instead of preparing a written report, I ask the privilege of making a motion to refer those papers to the Executive Committee, so that they shall pass upon them, select such data from them as they may think best, and have them distributed for information. I make that motion and ask for the discharge of the committee.

The motion was carried.

The committee appointed to recommend a place for holding the next meeting of the association submitted the following resolution, which was adopted:

"*Resolved*, That the next place of meeting of this association be in the City of Pittsburgh, at such date in February as the Executive Committee may determine.

Dr. Otto A. Moses, Mr. Stephen Holbrook and Mr. F.

A. Gilbert presented their resignations as members of the Executive Committee, which, on motion, were accepted.

Mr. S. A. Duncan, of Pittsburgh; Mr. T. Carpenter Smith, of Allegheny City, and Mr. Wells W. Leggett, of Detroit, were nominated as members of the Executive Committee to take the places of the gentlemen who had resigned, and there being no objection, the secretary cast the ballot of the association for the persons nominated.

DISCUSSION ON UNDERGROU ND WIRES.

Mr. LEGGETT: I believe that it was stated at the opening of the meeting that we would take up this matter of underground wires at the close of the session. I desire to state what position we are in at Detroit. At Detroit, as most of you gentlemen are aware, having seen our city, we are lighted by the tower system. We have some four hundred miles of wires in our system there. Just at the present time our City Council, our Board of Trade and our Mayor, all of them very excellent gentlemen who have at heart the welfare of our city (and there is no question but that they have at heart also the welfare of our company), have deemed it expedient on their part to immediately stop the operation of running the wires overhead. Now, we are met with this condition of affairs, that we do not know what to adopt. We would be very glad to have the views of this convention, or the views of such members of it as have had experience in this line, and to know if there is any system which any one can recommend that is beyond the experimental stage. We have invested in the city of Detroit nearly half a million of dollars in our plant, and you can readily see that we are driven to an extremity. That, of course, to us, is a matter of very grave importance. We want to know whether we are obliged to take one of a number of things, each of which is experimental, or whether there is some system which some person, some member of this association, can say that he has found to be expedient and practicable throughout for this purpose.

I must confess that after all our investigations in this matter we are as yet entirely undecided to know what to do. We recognize as well as our Mayor, our Board of Public Works and our City Council, that this matter of overhead wire is becoming a very serious one, interfering with fire ladders, causing more or less danger to property and to person, but the remedy is what we are seeking. If there is anything which we can adopt, we would be very glad to adopt it; and for that reason I hope that there will be short remarks from a number of sources, the experience of different individuals in this line, whether there is anything that they can recommend directly; and I should also be glad to know of the difficulties that they had experienced in regard to the matter. I would like very much if Mr. De Camp would state briefly whatever experience he may have had with the matter in Philadelphia; and, if we have a representative in the room from the city of Brooklyn, I would also like to hear from him.

Mr. DE CAMP: All that I can do is to state the facts of the case as it exists in Philadelphia. As Mr. Leggett says, it is certainly, with us, not beyond the experimental stage. There has probably been more work done in that direction in the city of Philadelphia than in any other city in the country, and this is the condition of it. The department known as the electrical department of the city of Philadelphia, about a year and a half ago made an appropriation of $5,000 to put down a line about one mile long. A lead-cased cable was laid, well insulated, put in a trough which was filled up with residuum of petroleum. That carried 12 lights of 30 volts each, which was the extent of that particular line.

At the end of a year a further appropriation permitted the department to extend its line. It, however, was not extended in a double line. The balance of the circuit was made on one side of the circuit, and the other was taken overhead. That has been in operation about six months. It is now carrying a load of lamps of 45 volts each, and has been doing that for probably the last three months. The cable is working fairly well, but from various causes has had more or less grounds on it—very many more than the overhead circuit. Additional experience was recently had at South street, where there was a circuit of one mile put in. The first circuit put in was taken up for some reason or other, it being a failure. The cable, which is there to-day, is a good one, but the superintendent tells me that the grounds are so numerous that he hardly knows where he commences to pick them out; and there they are to-day in that condition. Whether it is the fault of the cable or of the conduit or of the work done I do not know. That, however, has brought us to this conclusion, that we have got to replace all of that before we shall be justified in running lines over such a circuit.

The sectional underground wire operated by the Electric Light and Power Company, of which company I am the manager, is the latest experiment in the way of underground electric lighting which we have in Philadelphia. I have been manager of that company for six months. The gentleman in charge of that is a clever man, and a man of more practical experience in the operation of underground wire, I think, than almost any other man in the country. He is a man of exceptional intelligence, and is an enthusiast in his work. He has left no stone unturned to look into the difficulties which we have experienced and to try and foresee them. The conduit itself I believe to be one of the best structures in existence. I am speaking now merely for its convenience. It is an iron conduit. Previous to my taking charge of it, I do not know how many cables they had in; I do not know how they were selected, but certainly with the best judgment that the company then possessed.

Mr. BROWN, of Chicago: I have had about eighteen months' experience with underground work in Chicago. We have there the Dorsett conduit and are troubled greatly with gas and have had two or three explosions, although they have not caused much damage. We find that the principal trouble with the conduit is at the joint. We think if a perfectly tight conduit joint could be made that we would not be so much troubled with gas and even water that leaks in. The newest conduit which we know of in Chicago is the Hurlburt conduit, which has a flexible joint. It has been on the market but a short time, and I do not know that any of it has been laid. But it seems to me that it would carry out the expectations entertained regarding it from the fact that the joint is flexible. We have man-holes at an average distance of 400 feet apart, and between the man-holes we find that the conduit sags after it has been laid any length of time from the pressure from above—the street traffic. We have some 60 or 70 miles of wire under ground, and in that quantity nearly all classes of cable and underground wire are represented. We tried lead-covered cable at first, and finally thought it was best to give that up, but lately have gone back to it. We find that in many places lead covered cable fills the bill. On our main circuits running from the station we think it is best to make them of lead with wiped joints and after we leave the conduits, running through the laterals under the sidewalks, we find it would be best to have something besides lead cable, because, as you know, on all arc light circuits we have to get them everywhere and anywhere, at all times, to put in and to take out lights. Lead covered cables I do not think quite fill the bill under the sidewalk. We find it necessary, as I say, to have wiped joints on the lead cable and when we do leave the conduits we leave lead cable for good and put in some other wire. We also have great annoyance from the rats. They eat the lead of the cable. You can see where their feet burn on the cables, and their tails, and we find them on the ground with their noses burned off.

Mr. POWERS: I have been in the past year somewhat interested in this underground question. The principal cities of the State of New York, those outside of New York and Brooklyn especially, have been greatly exercised during the past year on account of the interference of the wires with the ladders of the firemen at the Buffalo hotel fire, and on account of that a number of bills were introduced and two or three were passed by the Legislature and signed by the Governor, allowing wires to be put underground with the consent of the local authorities. We told the contract board of the city of Troy that we would forsake our contract and would make no contract with them under any conditions that did not contain a clause eliminating the underground business. In other words, that our contract should be binding as long as our wires were overhead. Unless we are going to have a great deal of trouble in the small cities especially, it is necessary for the electric light men to take an uncompromising attitude. People say that because they want the wires underground is a sufficient reason why they must go underground. That is all they know about it. A prominent paper of the State of New York actually urged as an argument that because an Edison company in the city of Albany put their wires underground that we in the city of Troy should put our wires underground. Now in that state of ignorance it is the business of this convention to enlighten people on that subject as much as possible, and also to take the most uncompromising attitude toward forcing the wires underground. Let them understand that it is not possible in the present state of the art, especially where lights are spread over a large area.

Mr. DE CAMP: Mr. Powers' remarks call to mind a little early experience I had with legislative matters. About the first year we started there was a bill brought up in our council taxing overhead wires. It was put at $5 a mile for telephone and telegraph wires and $12.50 a mile for electric light wires. I said, "Gentlemen, I do not understand that; why should an electric light wire be taxed more per mile than a telegraph wire." One of the members turned around and said: "What is your name? Where are you from?" And then he moved to amend that by making the tax on electric light wires $15 a mile. That is the way your arguments, so far as this is concerned, are met.

The secretary read the following from Mr. F. E. Kinsman: Cannot the question of protection for lightning arresters be considered at the next meeting of this body?

The PRESIDENT: If Mr. Kinsman will talk with Mr, Keilholtz, of Baltimore, he will get some very valuable points on that subject.

Mr. LEGGETT: I would like very much to hear from the president on this subject and what experience he has had in Baltimore.

The PRESIDENT: We have not had any. I have declined for a good many years going before legislative or municipal committees for the simple reason that it is only a question of cost as to the feasibility of placing wires underground. It is a question I do not care to debate, because we do not want to put our wires underground. It costs too much.

Mr. LEGGETT: That is just the information I wanted to arrive at.

The PRESIDENT: It is very expensive, sir, but entirely feasible.

Mr. LAW: In Philadelphia we have had considerable trouble in conduits from the explosion of gas. There our lines are erected on iron poles made of gas pipe, and in two places lately we have cut holes in those poles and connected them with the conduits. I noticed that there was a considerable escape of gas from the top of those poles. I was up one of them the other day examining it, and it is very perceptible there—quite strong, and I would like to ask if there have been any experiments made in that direction.

Dr. MOSES: There is a little matter, but one of great importance—as trifles sometimes have a most important influence—there is a little thing that might be reported upon at some future meeting, and that is the influence of electric currents, both continuous and alternating, on small masses of magnetic matter, and on the demagnetization of the same. That is intended to cover the question of the rapid magnetization and demagnetization of small masses of iron used in measuring instruments; and also, what is the effect of currents, large and small, upon watches, which are in everybody's pocket; and whether it is possible for them to be demagnetized, when once they are really magnetized, by any appliances we have. It is a question of great importance, when you consider that the first chronometer that went accurately was the means of bringing the inventor a reward of £20,000 from the British Government. You can see it is a matter of importance to have time-pieces absolutely accurate for certain purposes. All of the chronometers used on board ship contain masses of iron in them, and it would not be pleasant to have somebody come down on an electric light compony for causing the magnetization of the chronometer and thereby bringing about the loss of a ship.

Dr. Moses' motion was carried.

The PRESIDENT: I appoint on that Committee E. Lange, of Pittsburgh. I will appoint on the committee on insulation, etc., to take the place of those who resigned, Prof. Elihu Thomson, of Lynn; Dr. Otto A. Moses, of New York; Dr. Leonard Waldo, of New Haven; Dr. Louis Duncan, of Baltimore; J. D. Lockwood, of New York; George A. Hamilton, of New York; O. M. Shallenberger, of Pittsburgh.

Prof. THOMSON: I thank the president for the honor of being appointed on that committee. I will endeavor to collect all the information I can in regard to this subject with the assistance of the other members of the Committee.

Mr. DUNCAN: If there is no other business before we adjourn, I would just like to call the attention of the convention to one point. I was not present yesterday morning when the report of the Carbon Committee was presented, and it seems to me that there is one point which interests local lighting companies which has been passed over without very much consideration, and in that connection it seems to me it would be well to take some action preparatory to the next meeting to look into this question of carbons very thoroughly either through the Executive Committee or some special committee: because, if we have got to break down a pool every two months, we ought to be in shape to do it, and it seems to me that, from the information which has been going around—not in the convention itself, but from mouth to mouth—in regard to the formation of an organization and the prices desired to be obtained by the old pool, that the time has arrived for the companies interested here through the committees of this association and through its proper officers to look after that subject very carefully. It seems that we have been able in the past to get along very comfortably with the pools, but I can conceive of circumstances where it might take considerable time to break up a combination. If that is the case it seems to me it would be well to have either a special committee appointed or the matter referred to the Executive Committee to keep it in hand. As I understand, the committee that reported yesterday morning was discharged. If they were discharged I should make a motion that a committee of three or five be appointed to take this matter in hand and that all papers pertaining to carbon be referred to that committee for report at the next meeting, and that they have power at any time to call the attention of the Executive Committee to any proposed action such as has taken place within the last few months. I think it is high time that we protect ourselves as well as that the parent companies protect themselves in the manufacture of carbon.

At the request of the president, Mr. Duncan put his motion in writing as follows:

Resolved, That a committee of three be appointed by the chair to inquire into and report on all matters pertaining to the carbon matter.

The resolution was adopted,

The PRESIDENT then declared the convention adjourned to meet in Pittsburgh on a date in February to be hereafter determined by the Executive Committee.

LIST OF EXHIBITS.

THE ELECTRICAL WORLD had its headquarters in parlors 7 and 9 at the Parker House, and there received calls from every one in attendance, whether as members or visitors. Owing to the lack of accommodation, many exhibitors had been unable to find an opportunity of bringing their specialties to notice, and they therefore availed themselves of the invitation extended by the WORLD to use its headquarters. The result of this was a display which crowded the large parlors from 10 A. M. till midnight daily, and was of the most varied and interesting nature, as will be seen from various items subjoined. Following its usual practice, the WORLD again issued its bulletin containing a list of those present, the programme of proceedings, an epitome of the work done in convention and a list of the exhibits. Between Tuesday and Thursday, no fewer than five editions of this bulletin were issued, each bulletin appearing on paper of a distinguishing color and each brought down to the hour of publication. An effort of this kind, made 200 miles from home, involves considerable work and expense, but the utility of the bulletin was once more so evident, that the staff of the paper felt well rewarded for the pains taken to make it trustworthy and as far as possible complete.

The success of the arrangements made and work done by the paper wa due to the energy and efficiency of its New England representative, Mr. W. I. Barker.

Despite the superiority of the incandescent light over gas as an illuminant for interiors, one difficulty has heretofore existed, particularly in its adaptation to domestic lighting, which has considerably retarded its application in this direction. We refer to the fact that it has heretofore been necessary to extinguish a group of lamps from the point of switching on, and impracticable to do so from an indefinite number of points, as in the case of electric gas lighting. This difficulty has arisen from the necessity of maintaining the electric circuit while the lights are in use. The New England Wiring & Construction Co., of Boston, exhibited in Parlor 7 a very ingenious device, patented and manufactured by themselves, whereby this difficulty is overcome, making it feasible to light one's hall lights from a vestibule, upon entering, and extinguishing the same from any room in the house, or *vice versa*. The device would probably be found of great value for watchman's circuits in mills, etc., etc. It is needless to add that it may be used on any system of incandescent lighting. This company also exhibited another of its manufactures, viz., the "Regulator" oil cup for dynamos and other high-speed machinery. The company are also agents for the Simplex arc lamp shown running on incandescent circuit in the cafe on the office floor. The company was represented by Messrs. S. B. Paine, W. J. Paine and H. B. Prindle.

The New England Glass Works, of Boston, displayed in Parlor 7 a great variety of its plain, decorated, ground, half ground and artistic globes for arc lighting purposes. The exhibit was in charge of Mr. S. O. Richardson, Jr.

The R. I. Telephone and Electric Light Company, of Providence, R. I., had on exhibition, in Parlor 7, several of its Little Giant batteries; and another of its useful appliances for use in hanging telephone cables, known as the Wright Cable Clip. Mr. R. H. Whittier, the manager of the company, was in charge.

The Standard Electric Time Company, of New Haven Mr. C. D. Warner in charge, had, in Parlor 7, a number o' its gauges for current indication. Its Warner pocket gauge for measuring small currents is well known, and its success augurs well for the new arc light gauge just brought out and placed on exhibition last week for the first time. The gauge was placed on one of the special arc

circuits running lamps in the hotel, and thus was in actual and continuous service every day.

Not a large, but a very interesting exhibit was that of the Billings & Spencer Company, of Hartford, Conn., in Parlor 7, of a number of its drop forgings of copper, iron and steel, for use in the construction of dynamos; also of its eyebolts and wrenches. This detail of manufacture is not as well known yet as it might be, but the drop forging is already to be found in a number of the best dynamos and motors.

The Fiberite Manufacturing Company, of Portland, Me., were represented by Mr. C. A. Brown, manager, who had in Parlor 7, a selection of "fiberite" jars made from ground wood pulp, and intended for primary and secondary battery purposes. This concern has developed a new and interesting industry at Skowhegan, Me., where the pulp is taken and made into the jars and other articles. It is said that these jars are found to answer admirably for use in connection with storage batteries driving street cars, where the work is necessarily rough and trying, and where glass and rubber appear to have little chance of long service. The jars shown were light, and had every sign of strength and durability. The company are making the jars in a great many sizes, and have facilities for a large output.

The Schaefer Electric Manufacturing Company, of Cambridgeport, Mass., had in Parlor 9, Mr. F. Schlegelmilch, son of the president, in charge, an exhibit of its lamps, switches, fixtures, etc., demonstrating the practicability of its system of incandescent lighting on arc or alternating circuit. The exhibit was decidedly pretty and effective.

Kimball & Davis, of Boston, had in Parlor 9 their new dynamo for incandescent lighting—a compact, neatly constructed machine, capable of sustaining seventy 50-volt lamps. Mr. Davis, of the firm, was in charge.

The Wainwright Manufacturing Company, of Boston, Mass., had in Parlor 9, under the charge of Messrs. Betton and Jacobs, samples of its feed water heaters, corrugated tubing, etc., already so extensively in use in electric light stations and plants in all parts of the country.

The Simplex Electrical Company of Boston, represented by Dr. A. F. Mason, manager, had on exhibition in Parlor 7 stout tree limbs from which the bark had been completely removed, leaving the bare wood polished, by friction against the Campbell insulated wire made by the company. The exhibit was accompanied by a letter from the superintendent of the station at Newton, Mass., stating that the wire had not been injured at all by the chafing. Dr. Mason also explained to many inquirers the working of the Simplex lamp elsewhere referred to, and described lately in these columns.

The exhibit of the Thomson-Houston Electric Company was made in rooms 64, 65 and 66, under the supervision of Mr. G. W. Davenport. It was necessarily limited, as a very much larger space would have been required to display all the apparatus and products of the company, but it was well selected, and remarkably interesting. In Room 64 were shown motors, station fittings and incandescent lamps. The room was lighted by a 6-light chandelier, the lamps of which were in circuit with a 1½ h. p. Thomson motor, operating an embroidering machine of the Worcester Corset Company, of Worcester, Mass., and a watch lathe of the American Watch Company, of Waltham, Mass. On the side table were shown a bank of lamps from ½ to 150 c. p., so arranged as to run on all the various systems employed by the company, viz., multiple, multiple series, plain series, alternating, etc. On other tables, neatly grouped, were a number of details of machines and lamps, including cut-outs, sockets, switches, etc. There were also shown the new volt meters and ammeters. In Room 65 were shown lights running off the new Thomson-Houston alternating system, taking current from a 25-light converter standing on the floor near by, receiving a current of 1,000 volts and transforming it into one of 50 volts. The lamps included a device for lowering the light, as in a gas jet, consisting of a coil, the introduction of which in the circuit deprived the lamps of a certain amount of current, and brought them down, if necessary, to a mere cherry red. Up in one corner of the room was some simple apparatus illustrating the remarkable phenomena produced by alternating currents, recently brought to the notice of the scientific world by Professor Thomson. Inside of a box shaped like a small pedestal was placed an alternating current coil serving as a primary. On top of this arrangement stood a closed jar filled with water and containing another coil of wire serving as a secondary, and connected with an incandescent lamp. When no current was on, of course no light came from the lamp; but as soon as the alternating current passed through the primary the lamp was lit up and compelled to rise from the water. As soon as the current was cut off the coil sank, and the lamp went out. Another experiment was shown on this coil, of a very striking nature, illustrative of the repulsive effect of the alternating current. The jar was taken away and replaced by copper rings and discs. Current being on, as soon as these discs were placed on the top of the pedestal they shot off at a high rate of speed, refusing to stay there. If lightly pressed down they emitted a strange noise, not unlike the muffled beat of a Chinese gong. If held loosely just above the pedestal, they dipped as though about to stand perpendicular. Another similar effect was produced by substituting for the discs a fire "blower," which, when held immediately over the pedestal, gave out a noise just like that of a big fog horn. As may be supposed, this apparatus was examined with the utmost interest and curiosity, not only by mere hunters after novelty, but by a great many of the members and delegates, some of whom were fortunate to hear Professor Thomson himself explain the phenomena involved. In Room 66 were some more lamps, running off a converter, and an easel on which rested a board of samples of electric welds made by the Thomson-Rice apparatus. As is known, this apparatus uses alternating currents, and that shown at the Lynn factory took a current of about 20,000 amperes at one volt making welds in cast iron, steel, etc., of ¼ inch diameter. The board contains samples of welds in a great variety of metals, and showed in some cases as many as half a dozen metals welded together. Altogether the exhibit was one of the most attractive ever made on such an occasion, being admirably illustrative of the many departments and ramifications of a great industry.

The Sun Electric Company made a very effective display of its new alternating system. The current was furnished from the central station of the Boston Electric Light Company, near Columbus avenue, and the lights shone brilliantly in the convention room, the executive committee room, some of the passage ways, and some of the rooms used as headquarters. The converter was located on the roof of the Parker House. The display included some very pretty effects, and was altogether very tasteful and effective. This temporary installation was made under the direction of Mr. F. Swan, superintendent of the incandescent department of the Boston Electric Light Company.

Blodgett Bros., of Boston, had in Parlor 7 some of their annunciators, of various kinds, for hotel, club, factory and other service. Mr. A. D. Blodgett was in charge.

Mr. A. L. Russell, of Boston, exhibited in Parlor 7 some of his generating and testing instruments. Mr. Russell, it may be noted parenthetically, is the successor of Charles Williams, Jr., with whom he was associated for many years, and has, as these instruments show, a keen perception of the wants of the electrical community as regards a most important department of work.

"Kerite" was represented in Parlor 7 and Rooms 305–6 by Mr. C. B. Hotchkiss and Mr. R. W. Pope. The exhibit included not only the familiar kerite specialties, but the Hotchkiss electric light wire, for which the demand will unquestionably be large. This wire is, in fact, double insulated, and the results of severe tests have well determined its merits.

Mr. Romaine Mace had in service in Rooms 18, 19, 20, 21 and 23, and in the corridors adjoining, a number of "Luminoid" lamps, made by the Vitrite and Luminoid Company of New York. He had also a number of lights running on the Sun Company's alternating circuit in the convention hall vestibule. The whiteness and purity of the light furnished was a subject of general comment.

The Cleveland Electric Motor Company exhibited in Rooms 18, 19, 20, 21 and 23 its motors of ¼, 1, 3 h. p. incandescent (110 volt); and 1, 3 and 5 h. p. arc, all mounted on a large square platform, about 2 feet from the floor. The 5 h. p. arc drove the 3 h. p. incandescent, serving as generator, the current from which ran the 1 h. p. 110 volt motor. The 3 h. p. arc ran the 1 h. p. incandescent for Vitrite lamps, exhibited by Mr. Mace for the Vitrite and Luminoid Company. A 1 h. p. arc also drove a 42-inch Blackman fan. Mr. C. L. Wright, manager; Mr. F. E. Pettengill, Mr. J. J. Miller, Mr. W. Anderson and Mr. G. W. Mansfield, electrician, represented the company. The motors were all of the new and compact form recently illustrated and described in these columns, with the single field magnet, and the novel manner of their exhibition and their use as generator as well as motor drew a very large number of visitors.

C. McIntire & Company, of Newark, N. J., manufacturers of patent electrical wire connectors, made a neat exhibit in Parlor 7 of their joints for electric light wires, etc. These joints were described and illustrated in the August 6 issue of THE ELECTRICAL WORLD. Mr. McIntire, the inventor, was in attendance.

The Standard Underground Cable Company, of New York, made, through Mr. Geo. L. Wiley, its New York representative, an attractive exhibit of its underground, submarine and aerial cables.

Mr. F. H. Bradford exhibited for the Kennedy Manufacturing Company, of Providence, a sample of a waterproof insulator made by them of a fibrous material, waterproof throughout and covered with a black enamel polished finish. It is light and strong and seems capable of good work indoors and outside.

The Edgerton Electric Motor Company, of Philadelphia, in Room 10, represented by Prof. N. H. Edgerton and Mr. W. E. Sharpe, made a remarkably neat and novel exhibit. It included a direct acting motor running a pump, doing its work admirably; also a motor on a ventilator, and another on a coffee mill. These all were the objects of attention, but the greatest interest was won by a boot-blacking apparatus devised by Prof. Edgerton, which blacked hundreds of delegational boots all day long with the utmost ease and dispatch.

The Okonite Company, of New York, in Rooms 70 and 71, made an excellent display of their cords, wires and cables for general purposes and for electric lighting service. Visitors were anxious to secure the pretty little rubber mats presented by the company, bearing its name on the margin and looking not unlike a section of a large cable with the cores protruding. Mr. W. L. Candee and Mr. G. T. Manson were in charge.

The Washburn & Moen Manufacturing Company, of Worcester, Mass., made a good display on the office floor of their celebrated wire products, all inclosed in a large glass case.

The Electrical Accumulator Company, of New York, showed, in Room 71, several types of its storage battery, including that recently used with such success in running a car in Philadelphia, under the direction of Mr. A. Reckenzaun. The interest displayed in the cells was general and lively, and, as will have been seen, the subject of storage occupied much of the Convention's time.

The Leatheroid Novelty Company, of Boston, had on exhibition a neat sample board containing a number of its products for various electrical uses.

Mr. P. C. Holmes, of Gardiner, Me., exhibited in Parlor 7 an unusually fine model of a new turbine water-wheel of his own design, specially intended for the operation of electric light plants by water-power. This wheel has been adopted by the Lewiston & Auburn, Me., Electric Light Company for their new plant. It has a high percentage of useful effect. The form of the wheel gives a light bearing on the step, which is so arranged that it can be readily adjusted to its place, in case of wearing, without going into the wheel pit or stopping the wheel. The concern has a reputation of many years for its cut gears for water wheels, etc.

The Boston Rubber Shoe Company, of Boston, represented by Mr. G. L. Richards, had, in Parlor 7, a sample board of its rubber tape, specially adapted for use on electric light and telephone wires, for splicing joints, etc.

The Scovill Manufacturing Company, of Waterbury, Conn., had in Parlor 7 samples of its silicon-bronze wires, high resistance German silver wire, etc. It was represented by its expert, Dr. L. Waldo, who brought before the convention some very interesting data on wires and showed a new instrument for submitting wire to a bending test.

The E. P. Gleason Manufacturing Company, of New York, had a fine exhibit in Parlor 7 of glassware, fixtures, fittings and appliances for incandescent lights. Mr. E. F. Gennert and Mr. W. F. Cullen were in charge. The display included appliances for lamp protection in exposed places, and gave altogether an excellent idea of the æsthetic possibilities of the incandescent lamp.

The Para Rubber Company, South Framingham, Mass., showed some of its insulated wires, a quantity of which had been used with good results in the Sun Company's exhibit. The insulation is of rubber.

The New England Telephone & Telegraph Company kindly furnished the members of the association with a set of its finest telephone instruments, which was put in the room occupied by the Executive Committee. Mr. A. H. Chapman, one of the officers of the company, deserves the thanks of every one who attended the convention, inasmuch as it was he who suggested the advisability of furnishing the convention with telephonic facilities during the session just closed, and it was under his personal supervision that the work was carried out.

The Bernstein Electric Light Manufacturing Company, Boston, Mass., exhibited in Parlor 7 its means of using incandescent lamps on arc-light circuits; the 125 c. p. lamps (there were two in number, located in two of the corners on tall structures) were used in direct series with the arc lamps; and each was on a fixture compact and complete in itself. This fixture combines the hanger-board, short-circuiting switch, lamp-socket and support for the lamp-shade. There were also four 30 c. p. Bernstein lamps hung intermediate between the two previously referred to, and arranged on structures neatly decorated and festooned. These lamps were connected two in multiple on the differential cut-out by a very simple method of wiring, which was fully shown in the company's exhibit. The display was looked after by Mr. H. B. Cram, treasurer of the company, assisted by Mr. O. S. Bussman, electrician.

The Emerson Power Scale Company, formerly of Lowell, and now located at Florence, Mass., had its novel and useful instrument on exhibition in Room No. 9. Mr. E. A. Thissell, the manager of the company, remained constantly by his power scale, showing its wonderful accuracy and practical adaptability for the measuremen tof power.

Throughout the convention, the handsome quarters of the Boston Electric Club, at 66 Boylston street, were open to the delegates, many of whom made their way thither and were most hospitably entertained. As has been noted elsewhere, the hospitality of the club found more than one channel and form of expression, the members vying with each other in their desire to make the visitors feel at home at the Hub.

Availing itself of the opportunity presented by the assemblage of so many of its agents in Boston during the week, the Thomson-Houston Company issued invitations to them for a dinner at Young's, on Thursday evening, Aug. 11, at 6.30 P. M. Nearly forty gentlemen sat down together at that hour, including Vice-President Coffin, who was in the chair, Messrs. S. A. Barton and E. W. Rice, Jr., Mr. H. C. Davis, Prof. Thomson, and others well known as the company's representatives. After the dinner came what might be termed a symposium, in which any one of the party was at liberty to state his experience or views and to ask questions as to the apparatus, the best plan of work, etc. As may be imagined, the occasion was thus one of peculiar interest and benefit to all participating, and cannot fail to be highly stimulative to progressive work by the Thomson-Houston companies and agents in every section of the country.

The C. & C. Electric Motor Company, of New York, had in Room 6, under the charge of Mr. H. F. Lufkin, one or two of its small motors with fan attachment, and the compactness of the arrangement was very favorably commented on.

The Baxter Electric Manufacturing and Motor Company, of Baltimore made in the large Parlors 1, 2 and 3 what was undoubtedly the finest exhibit ever attempted in connection with the meetings of the association. It was not simply a big display, but it was well arranged and very comprehensive, bringing out admirably the ease with which the electric motor can be adapted to almost every kind of work. Great as must have been the expense connected with such an exhibit, the company will, if one may judge from the comments of the hundreds of visitors to the parlors, reap a rich reward for its outlay and trouble. The machinery operated by Baxter motors included a seam pressing and finishing machine made by Ward & Wright, of Lynn; a printing press from C. B. Cottrell & Sons, of New York; fifteen sewing machines from V. K. & A. H. Jones, of Lynn, employed in the manufacture of ladies' fine shoes. These machines were tended by fifteen lady operators and were surrounded by crowds of people all day long. The apparatus running also included Wheeler & Wilson's vamping machine; Wilcox & Gibbs' lining machines; Jordan & Marsh's shirt machine; boot button machines of the Standard Button Fastening Company, of Boston; Clark's cord machine, top-stitching machine and front and back-staying machine; a Blackman ventilating fan and a B. F. Sturtevant steel pressure blower. The largest motor, a 10 h. p., ran an incandescent machine supplying current to a number of Sawyer-Man lamps which lit the range of parlors very effectively. The exhibit was in charge of Messrs. T. McCoubray, Jr., W. Baxter, Jr., P. O. Keilholtz and D.

E. Evans, and assistance was rendered by the Boston Electric Light Company, local agents for the motor.

The Sawyer-Man Company, represented by Mr. P. H. Alexander, had one of its machines in Parlors 1, 2 and 3, run by a 10 h. p. Baxter motor, and carrying a load of about 50 incandescent lamps. The lamps were well distributed, and made a highly creditable exhibit.

The New York Insulated Wire Company, of New York, manufacturers of the Grimshaw white core wires and cables, also Grimshaw tape, had on exhibition in Room 173 a full line of their product in charge of J. W. Godfrey, of New York, the General Manager of the company.

The Geneva Non-Magnetic Watch Company (limited), of New York, had a neat display of its non-magnetic watches in Rooms 5 and 6. This exhibit was in charge of A. C. Smith.

The Callender Insulating and Waterproofing Company, of New York, showed a line of its specialties in insulated wire, etc., in Rooms 73 and 74. The company was represented by Mr. W. M. Callender and Mr. A. W. Butterworth.

The American Tool and Machine Company, of Boston, Mr. W. H. Barker in charge, showed in Parlors 1, 2 and 3 its dynamo starter and stopper, obviating the use of loose pulleys, etc. The device naturally attracted considerable attention.

In Parlors 1, 2 and 3 Mr. C. L. Ireson exhibited his well known self-adjusting leather link belting, for which he claims many advantages in driving high-speed machinery, including dynamos, great steadiness and a high efficiency being obtained.

THE VISIT TO THE THOMSON-HOUSTON FACTORY.

The whole of Wednesday afternoon was given up to an excursion and a visit to the Thomson-Houston factory at Lynn. The party, numbering about 250, left the Parker House at 12:30 and proceeded on board the steamer "J. Putnam Bradlee," put at the disposal of the association through the kindness of Mayor O'Brien. The first stop was made at Deer Island, where an inspection was made of the Reformatory, and where the boys gave an excellent vocal and instrumental concert in the chapel. Dr. Moses, whose connection with benevolent work in New York is well known, addressed the boys in words that could not but encourage them in good resolves, and in their endeavor to master a trade. On leaving the chapel the party took lunch in one of the buildings on the Island, and then, reshipping, went on to Nahant. At this place a number of stages were waiting, and in these a pleasant drive was made along the neck of land to the factory at Lynn. There each stage load of visitors, under the guidance of one of the Thomson-Houston staff, inspected the huge factory from top to bottom. The establishment is one of the largest of the kind in the world. At the present time over seven hundred men are employed, and the new wing about to be built will more than double the productive capacity. Some idea of the magnitude of the work may be formed from the fact that the arc light department can turn out 300 lamps weekly and is now in full blast. The factory building, which is four stories high with a floor space of about 80,000 square feet, requires some 450 h. p., is lighted by 120 arcs and 300 incandescents, heated by steam, and is furnished with ample water from artesian wells on the premises.

In the dynamo department a number of new machines were found under test, including the new alternating machine, self excited, which the company is putting on the market. Elsewhere the converters of various sizes were also shown. In the incandescent lamp department, hundreds of lamps were testing, and the details of manufacture were very freely exposed. Great interest was taken by everyone in the practical exhibition of the simple electro-welding apparatus invented by Prof. Thomson; and as each party arrived at that part of the factory, new welds were made for their amusement and information. Prof. Thomson himself was at hand to furnish, as he can so well do, a brief sketch of the principles involved. The testing rooms, pattern rooms, winding rooms, etc., were all invaded, and it was with reluctance that the departure was made by train from Revere Beach depot at 6 P. M. for the Point of Pines, where dinner awaited.

At 7 P. M., Mr. Ridlon, president of the Boston Electric Club, called to order in the banqueting room of the Point of Pines Hotel a company of not less than 300, and then introduced Dr. Moses as the presiding officer of the evening. At the call of Dr. Moses, tremendous cheers were given for the Boston Electric Club, the Thomson-Houston Company and the city of Boston, who were acting so royally as entertainers of the association. Then in response to mention of their names, Professor Thomson, Mr. Ransom and Mr. Slattery each made brief and felicitous response, Mr. Slattery answering to the toast of the Boston Electric Club. Doctor Moses then gave the toast of President Morrison, who was cheered to the echo.

Mr. MORRISON said: If you will accord to me for a few moments the courtesy which has so distinguished you during all these years while we have been associated together, I will endeavor to say a word or two. It was most unexpected on my part to be called upon to say anything at this time. In the programme which I assisted in making for this evening, the next regular toast would have been to the electric lighting company to whose bounty you are indebted for this very pleasant evening's entertainment. But favors sometimes go entirely beyond merits, and such is the favor that has fallen upon me through the kindly feeling which has existed during all these years between you and me. And so I am placed before those who have earned the honors of the evening. Once in a lifetime, perhaps a little oftener, comes an occasion of this kind with a sudden outburst of good fellowship, and to-day it greets the gathering of men of science and men of work assembled together in the goodly city of Boston at this time. Words of wisdom and words of welcome such as are rarely said to men gathered together as we are have greeted you to-night. You have here, in my judgment, the cream of the manhood of the electric business in the United States. One of the speakers in the National Electric Light Association to-day—I think Mr. Steuart, of Baltimore—said that on that floor were represented twenty-six of the States of the Union. What did that mean? Why, it meant that on the floor of the Parker House to-day stood a full representation from twenty-six States of this Union, showing the intelligence and the nerve and the pluck of the men who have stood at the front and made a new business a phenomenal success in the short period of eight or nine years. Mr. Steuart asked you to assist him in reorganizing the patent laws. And he asked you to go to the Congressmen of your districts—you, gentlemen, who represent twenty-six States of this Union on the floor of this house to-night, and give him the needed aid to clean out that nest of politicians, and put in their places men of science, who know and understand their business.

When this association struggled into birth in the city of Chicago, two years and a half ago, its most earnest advocates could have hardly looked forward to such a meeting as is present here at this sixth semi-annual convention of the National Electric Light Association. A few men gathered together in the Grand Pacific Hotel at Chicago, and they have grown from the small handful of men to the three or four hundred men who have sat down here at this banquet of the Electric Club of Boston, under the auspices of the Thomson-Houston Electric Company in this beautiful place to-night. Are we not rewarded for our labors? Do you not feel proud to belong to the National Electric Light Association? Is there a man here who does not feel a thrill of glory, such as soldiers sometimes feel, when you look down these well-filled ranks to-night? Honor after honor has come to me, yet I will say I am as ready to serve in the ranks of your association as in the office of president. I want, in the name of the National Electric Light Association, to return our thanks to the Thomson-Houston Company and their coadjutors of the Electric Club of the City of Boston, so ably represented by their president and Mr. Slattery on this floor to-night. I hope that when I take my seat—I do not hope, I know—that you will accord to the representative of that company, upon whom I am about to ask the toast-master to call, the same respectful hearing that you have given to me. Your affection for me is fully appreciated by me, and I ask you to continue that respectful attention.

Dr. Moses then called on Mr. Coffin, the vice-president of the Thomson-Houston Company.

Mr. COFFIN: Mr. Chairman and the President of the National Electric Light Association and Gentlemen of the Association, I thank you for the honor conferred upon me. I thank you in the name of the Thomson-Houston Company that so many of you gentlemen have come from so far, have weathered such torrid heats, have in the persons of many of you perhaps conquered some prejudices, and have all of you, from first to last shown us such great kindness, such constant attention and such uniform courtesy on this occasion. It is not unusual at the close of a day or the close of life to remember our blessings. To night it is proper for members of this association, and for the members of the parent companies—to use a common term which I do not like, because it signifies that some are children, and we are in fact all of the same age—it is not improper for us to remember our blessings. Among them are, first, membership in such a goodly body, an intelligent body, with a sprinkling of the scientific element, to which we can all pay tribute if we cannot all understand it. We should be thankful that we are members of an association, are exponents and promoters and representatives of that department of science and industry which attracts to it and draws around it so much of education and intelligence and manhood.

It is unusual, it is impossible, to find in any other of the fields of industry, in my opinion, anything which attracts so readily, so spontaneously, such a large percentage of our educated, earnest young men of convictions, as does ours. With regard to the future of electric lighting, these men believe that if it is promoted, first, upon scientific, truly scientific principles, and, secondly, upon business principles, it must succeed. It is impossible to look upon the faces of the gentlemen here assembled to-night and not be convinced that those of you who cannot be scientific electricians are earnest and determined to promote your business upon a business and manly principle, with the intention to get the most that can be got legitimately out of the business. It is my pride, gentlemen, that young men leaving the colleges are flocking around the standard of this comparatively new industry. A gentleman has left the army, a gentleman whom I hoped to see here to-night, a lieutenant of fine and high promise, and turned his back upon all that his position promised him if he would remain in that profession, to take up the more promising work of electric lighting. We have here, I am happy to say, not in the electric light business directly, but in that which contributes to it, without which electric light is not possible, the carbon business, the son of an honored ex-President of the United States. These things will in themselves show the attraction of the new industry, of which we are proud to be the standard bearers. Our honored president also informs me that we have some half a dozen members of the United States Navy, who, strange as it may seem, forsake the navy of the United States for the field of electric lighting. More strange than all, perhaps, we have several representatives here of that field of manufacture—that honored field—I am talking with perfect respect and admiration—that antiquated field of manufacture—that of the gas companies. (Great laughter.) Now, gentlemen, I feel very much as though, if I talked to you longer, somebody would say to me as a good old Methodist deacon said of a fellow Methodist deacon in prayer meeting. He said: "I wish Brother Jones was in hell." It created a sensation. But he insisted that he was honest in saying so, because if Brother Jones was in hell he would break up the whole institution in less than six weeks. I am also reminded of a colored preacher, an earnest soul, who was once preaching about the sins of his parishoners, and who said that of all sinners the worst was the one who robbed his neighbor's hen roost. Some layman got up and said, "Hold on, there, brother, you are throwing a coldness over this meeting." Now I fear that I shall throw a coldness over this meeting. I will say no more, therefore, except to return sincere and heartfelt thanks to these our hosts of the evening whose grateful guests we are, the Boston Electric Club. I only regret that there are not here present representatives of the city of Boston, the bounty of which city we have been the grateful recipients of to-day. Hoping, gentlemen, to see you again soon, and hoping this convention may be presided over in the future by a gentleman of as great earnestness and as great executive ability as are possessed by the president whom it has been your good fortune to have in the past, I will bid you good night. (Loud applause.)

At this stage Dr. Moses had to reply to the cheers given for the chairman, and then called upon Mr. Slattery, who commented very neatly on the manner in which the associated had "alternated" between intellectual pursuits and social pleasures during its stay in Boston. He then requested Mr. A. Steuart, of Baltimore, to address the company.

Mr. Steuart said: It is with the greatest diffidence that I get on my feet, even under such an urgent request, after the eloquence that we have listened to. And I can only venture to say to you that we have been much more than eclipsed by the magnificent hospitality we have received here to-day. I am in your midst representing an interest that appears to be somewhat foreign to electric lighting. And yet I think if you will consider for a moment you will find that it comes home very close to the interest of every electric lighting man. My interest here is of course scientific and at the same time I am concerned with the general lighting business; but principally it is for the purpose of attempting to secure your co-operation in bringing about certain reforms in the patent system of this country. With 26 States of this Union represented in this Association, and something over $300,000,000 invested in electric lighting, or in collateral enterprises, and almost every dollar of that money invested under a patent of some kind, we are beset with inventors and applicants for patents who are going into the Patent Office, which has many points of virtue, but which, I am sorry to say, is full of error which we have power to correct. I wish only to dwell upon one evil, which is the principal one. It is the great evil of political machination in that office. Suppose anybody were to make the attempt to run the National Electric Light Association or the business represented in this assembly by putting politicians into your stations and factories who knew no more about electricity than a pig does about Sunday. Would you expect your interests to be protected? I want to be guarded in what I say, because I have the very highest regard for so many of my friends who are in the Patent Office, But this evil is a great one. Now, with that state of things existing throughout the department, it is not surprising that every room in the office is from one to six months behind hand with its work and that the personnel of the office is far from good in many respects. The committee that was appointed to consider this question reported to your body yesterday a bill which, if it should pass, would remedy many of these difficulties. That bill will be introduced into Congress. We call upon the members of this association to aid the committee in having that bill passed. See your representatives in Congress, and make it a personal matter with each of them to urge the passage of this bill. We can have it made a law, and then we can feel that the money invested in electric lighting is safe.

Brief speeches were then made by Mr. Barton, of the Thomson-Houston Company, Mr. W. C. Kerr, Mr. S. A. Duncan and Mr. A. Reckenzaun, and the company then left the hall and took train for Boston about 10:30 P. M.

No praise could be too high for the genuine spirit of hospitality manifest, and for the excellence of the management in carrying out a programme that extended over nearly 12 hours and embraced so many changes of scene and styles of travel. The efficient Entertainment and Reception Committee of the Boston Electric Club consisted of P. H. Alexander, chairman; F. A. Gilbert, A. H. Chapman, B. S. Flanders, R. F. Ross, M. M. M. Slattery, W. Brophy and G. W. Adams. On the part of the Thomson-Houston Company, Messrs. Coffin, Barton, Garfield and Hosmer, and Prof. Thomson, as well as the whole of its large staff, were indefatigable in their attentions.

Edison's Pyro-Magnetic Generator.*

As a heat engine, the thermo-cell appears to follow precisely the law of Carnot, and hence can have at the most no higher efficiency than the reversible engine of this eminent philosopher. If, therefore, the result hoped for is to be attained at all, it must be looked for in some other direction. It has long been known that the magnetism of the magnetic metals, and especially of iron, cobalt and nickel, is markedly affected by heat. Since, whenever a magnetic field varies in strength in the vicinity of a conductor, a current is generated in that conductor, it occurred to me that, by placing an iron core in a magnetic circuit and by varying the magnetizability of that core by varying its temperature, it would be possible to generate a current in a coil of wire surrounding this core. This idea constituted the essential feature of the new generator, which, therefore, I have called a pyromagnetic generator of electricity.

The principle of utilizing the variation of magnetizability by heat as the basis of electric machines, though clearly applicable to generators, was first applied to the construction of a simple form of heat engine, which I have called a pyromagnetic motor. A description of this motor will help us to understand the generator subsequently constructed. Suppose a permanent magnet, having a bundle of small tubes made of thin iron placed between its poles, and capable of rotation about an axis perpendicular to the plane of the magnet, after the fashion of an armature. Suppose, further, that by suitable means, such as a blast or a draught, hot air can be made to pass through these tubes so as to raise them to redness. Suppose that by a flat screen, symmetrically placed across the face of this bundle of tubes and covering one half of them, access of the heated air to the tubes beneath it is prevented. Then it follows that if this screen be so adjusted that its ends are equidistant from the two legs of the magnet, the bundle of tubes will not rotate about the axis, since the cooler and magnetic portions of the tube-bundle (that is, those beneath the screen) will be equidistant from the poles and will be equally attracted on the two sides. But if the screen be turned about the axis of rotation, so that one of its ends is nearer one of the poles and the other nearer the other, then rotation of the bundle will ensue, since the portion under the screen, which is cooler and therefore magnetizable, is continually more strongly attracted than the other and heated portions.

This device acts, therefore, as a pyromagnetic motor, the heat now passing through the tubes in such a way as to produce a dissymmetry in the lines of force of the iron

* Abstract of paper read before the American Association for the Advancement of Science, New York, August 15, 1887, by Prof. Barker, from Mr. T. A. Edison.

field, the rotation being due to the effort to make these symmetrical. The guard plate in this case has an action analogous to that of the commutator in an ordinary armature. The first experimental motor constructed on this principle was heated by means of two small Bunsen burners, arranged with an air blast, and it developed about 700 foot-pounds per minute. A second and larger motor is now about finished, which will weigh nearly 1,500 pounds, and is expected to develop about three horse-power. In both these machines electro-magnets are used in place of permanent magnets, the current to energize them being derived from an external source. In the latter machine the air for the combustion is first forced through the tubes to aid in cooling them and then goes into the furnace at a high temperature.

The generator consists of eight electric magnets, radially arranged around poles, connected with two discs of iron through which pass, opposite these poles, eight rolls of thin corrugated wire. When the magnets are charged, these rolls are magnetized, and the current is generated in the coils. The apparatus being placed on a furnace and hot air passing through these rolls, called interstitial armatures, they become non-magnetic by heat. Beneath the lower disc a semi-circular plate is made to revolve, so that it cuts off heat from one-half the armatures, four being heated and four cooled continually. The current of electricity being generated in them all, the direction in the four under the guard plate is opposite to that of the four without. The separate coils are then so connected that the currents so generated are given a common direction by a commutating device.

The entire machine now described is placed upon the top of any suitable furnace, fed by a blast, so that the products of combustion are forced up through those interstitial armatures which are not covered by the guard plate, and raise them to a high temperature. The field magnets when charged magnetize, of course, only those interstitial armatures which are cold; that is, those beneath the guard plate. On rotating this plate, the interstitial armatures are successively uncovered on the one side and covered on the other; so that continually during the motion four of the eight armatures are losing heat and the other four are gaining heat. But those which are losing heat are gaining magnetism and vice versa.

The potential difference developed by this dynamo will obviously depend (1) upon the number of turns of wire on the armature coils, (2) upon the temperature-difference in working, (3) upon the rate of temperature-variation, and (4) upon the proximity of the maximum point of effect. No advantage will be gained, of course, by raising the temperature of the interstitial armature above the point at which its magnetizability is practically zero; nor will it be advantageous on the other hand to cool it below the point where its magnetism is practically a maximum. The points of temperature, therefore, between which, for any given magnetic metal, it is most desirable to work, can easily be determined by an inspection of the curve showing the relations between heat and magnetism for this particular metal.

The results thus far obtained lead to the conclusion that the economy of production of electric energy from fuel by the pyromagnetic dynamo will be at least equal to, and probably greater than, that of any of the methods in present use. But the actual output of the dynamo will be less than that of an ordinary dynamo of the same weight. To furnish thirty sixteen-candle lights in a dwelling house would probably require a pyromagnetic generator weighing two or three tons. Since, however, the new dynamo will not interfere with using the excess of energy of the coal for warming the house itself, and since there is no attendance required to keep it running, there would seem to be already a large field of usefulness for it. Moreover, by using the regenerative principle in connection with it great improvement may be made in its capacity, and its practical utility may very probably equal the interestin g scientific principles which it embodies.

The Clam Bake of the Year.

For the past eight years it has been the custom of the American Electrical Works of Providence, R. I., to entertain its numerous friends and patrons with a genuine Rhode Island clam dinner, which has usually been held at one of the many charming resorts for which Providence is noted. On Friday last, August 12, the ninth annual clam bake was enjoyed at the Vue de l'Eau Club, at Silver Spring, by the largest gathering which has ever been present at one of these notable entertainments. A number of the members of the National Electric Light Association attended, and to many of the guests, especially those who were unacquainted with the mysteries of a genuine Rhode Island clam bake, the affair was a series of pleasant surprises and revelations. Every means for enjoyment was provided, and base-ball, archery, target shooting, foot-ball, to say nothing of many surreptitious games, were indulged in. The game of base-ball between the fat men and the lean resulted in a score of 17 to 1 in favor of the latter. Only two innings were played. An appetizing lunch was spread at about 11:30 and as soon as the "heavy weights" discovered this fact, they quietly adjourned to the Club House and forgot to return to the ball field. The usual group photograph was taken. Dinner was announced at 3 P.M., and was promptly dispatched by the following gentlemen:

BALTIMORE.—T. McCoubray, Jr.
BOSTON.—A. D. Blodgett, J. H. Allen, J. S. Lowell, H. S. Thornberry, N. W. Lillie, T. D. Lockwood, W. S. Hill, G. M. D. Fernald, J. W. Poole, G. W. Adams, H. B. Cram P. H. Alexander, E. P. Sparrow, Frank Ridlon, M. C. Ayres, D. W. Dunn, F. E. Morris, F. A. Gilbert, H. Hall, C. C. Allen, Chas. L. Ireson, R. F. Ross, Louis W. Burnham, F. A. Harsgood, Charles Burgher, J. W. Larish, J. C. McCoy, H. J. Miller, A. L. Russell, A. A. Ziegler, A. H. Chapman, W. C. Woodward, J. H. Clark, Geo. Simmons, F. M. Lytle, W. M. Smith, Thos. Pray, Jr., P. Fahey, T. B. Baily, W. I. Barker, M. S. Lewis.
BROOKLYN.—E. F. Peck, C. Mortimer Wiske.
CINCINNATI.—F. A. Kelly.
COVINGTON, Ky.—Ed. C. Sellers.
DUBLIN, IRELAND.—W. P. O'Donoghue.
FALL RIVER.—Chas. Sylvester, Geo. G. Grush, Spencer Borden.
FORT WAYNE, Ind.—J. A. Jenney, Fred'k Schaefer, P. A. Randall.
HARTFORD.—N. H. Stevens, J. A. Dalzell, Merle J. Wightman, J. J. Gates.
KEENE, N. H.—F. M. Tottingham.
LYNN.—J. F. Baker, F. W. Webster, A. L. Rohrer.
MILFORD, Ct.—C. A. Lyman.
NASHVILLE, Tenn.—J. W. Braid.
NATICK, Mass.—S. O. Daniel.
NEWARK, N. J.—C. O. Baker, Jr., Geo. M. Robertson.
NEW BEDFORD.—K. S. Taber, W. K. Wagner.
NEW HAVEN.—E. B. Baker, E. N. Clarke, G. S. Pond, R. D. Blish, F. N. Hooker, W. A. Harris.
NEWPORT.—J. Carroll.
NEW YORK.—H. C. Davis, C. W. Price, Otto A. Moses, W. R. Frary, Z. Latshaw, M. W. Goodyear, F. Pennell, J. A. Seely, W. E Huntington, G. A. Hamilton, P. C. Ackerman, C. E. Stump, R. W. Pope, Gerritt Smith, Chas. A. Tucker, Romaine Mace, M. W. Gleason, Wm. F. Cullen.
PATERSON, N. J.—J. F. Noonan.
PAWTUCKET.—C. H. Bullock, H. W. Hamblin.
PHILADELPHIA.—A. J. De Camp, H. A. Cleverly, Stephen Holbrook, W. B. Buchanan, Geo. F. Porter, W. E. Sharpe, A. Reckenzaun.
PROVIDENCE.—E. M. Carhart, E. C. Perkins, J. H. Russell, E. W. Fyler, A L. Kilbourne, J. M. Addeman, R. T. Robinson, L. W. Clark, F. E. Chafee, Geo. H. Thurston, Geo. W. Millard, V. A. Thomas, H. E. Chubbuck, Chas. T. Howard, J. W. White, C. H. Douglass, Geo. H. Adams, Chas. E. Lincoln, John O. Darling, E. F. Phillips, H. C. Bradford, Geo. H. Darling, R. H. Whittier, Chas. G. A. Peterson, Geo. A. Steer, A. C. White, W. N. Munro, L. L. Burdon, W. H. Sawyer, Gardiner C. Sims, W. A. Hathaway, John J. Drake, C. R. Remington, Jr., H. H. Sherman, H. W. Kilbourne, W. A. Dempster.
TAUNTON, Mass.—A. Coleman.
WASHINGTON, D. C.—Fred. W. Royce.
WATERBURY, Conn.—F. W. Lane, L. S. White, A. C. Mintie, A. O. Shepardson.
WOONSOCKET.—L. C. Lincoln.
WORCESTER, Mass.—W. Brophy.

The dinner opened with a great ovation to Mr. Eugene Phillips, the president of the American Electrical Works. Dr. Otto A. Moses, of New York, officiated as toast master, and most acceptably filled the position. Some very appropriate speeches were made by Mr. T. D. Lockwood, Prof. Reckenzaun, Mr. Henry C. Davis, Mr. P. H. Alexander, Mr. R. W. Pope, Mr. W. P. O'Donoghue and others. The memento of dinner was the menu card, which was illustrative of the occasion. It was made up in the form of a huge Chinese firecracker, and as it stood at each plate the pictorial menu sheet significantly indicated what was to follow and what did follow. A more jovial crowd never sat at table, and when the hour for closing the festivities came, three rousing cheers were given for the host of the day and the "Clam Bake of the Year."

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, Aug. 15, 1887.

The United States Electric Lighting Company, 120 Broadway, are shipping a big arc and incandescent plant to the city of La Paz, Bolivia. The company's long distance system will be used, the plant including two 225-light incandescent machines for street lighting and two 500 lighters for commercial purposes. A 10-light arc machine also goes for park or plaza lighting. The whole plant has been planned for steam and water, by Mr. D. E. Drake, the manager of the engineering department of the company. Water can be had for motive power eight or nine months in the year. Coal is so very expensive that resort is had to manure as fuel. La Paz, it may be stated, has between 60,000 and 70,000 people, and stands several thousand feet above sea level. It is highly encouraging to see so fine a plant of apparatus sent abroad, and I hope it may bring in a number of orders.

In my notes last week I spoke about the Edson gauge readings for the American plant on Liberty Island, but by an oversight I omitted to mention that the steam plant referred to was that installed by E. P. Hampson & Co. through Mr. W. F. Haring. The steam plant, comprising an Armington-Sims engine put in by the company, is a decidedly fine piece of work, as, indeed, the gauge record showed; and I have heard some flattering comments on its operation. By the way, I am told that the whole plant will receive detailed attention in the forthcoming report of the Lighthouse Board, under the hand, it is said, of Major Heap.

Electrical circles, especially the telegraphic ones, have been very busy discussing the rumored cable deal. There is no question as to the fact that some important transactions are being negotiated. In fact I have it on very good authority that the matter would be closed up except for the opposition that Mr. Jay Gould is making in regard to one or two details. What point he wishes to score is not exactly known. It would be a good thing to see some harmonization of the cable interests, though not in the shape of a renewal of the old Western Union monopoly. The drift of affairs may be gathered from the report of an interview between an *Evening Post* reporter and a gentleman interested in the Commercial Cable Company. In reply to inquiries the gentleman in question said: "I am not in direct communication with Mackay, but from what I have been able to learn there is no doubt in my mind but that the long war is over. I do not think the Commercial Company will join any pool and accept a percentage of the cable busines which is carried on between this and other countries, but there is no doubt of a rate per word being decided upon, with which everybody concerned will be satisfied. I think that a satisfactory agreement will be made, by which rates will be fixed at reasonable figures and each company will attend to its own business. I don't think you will ever again see the existence of a pool which will regulate the amount of business each company in it is to have, and the day of a monopoly in the cable business is over. You will never see again all the companies in the cable business under one management. The settlement will be one simply fixing a uniform rate, and each company will do all the business it can." Should the present negotiations fall through, I should not be surprised to see the Commercial Company make a cut to 12 cents, which would be a bad blow for the pool that has already been running so long and wearily at that rate. It is said that the Western Union desire a 50 cent per word rate, the Direct Cable people are willing to go to 60 cents. The French and Anglo-American companies would agree to any figure high enough, while Mackay insists upon not over 40 cents and prefers 25.

I am informed that Mr. Jay Gould's house at Forty-seventh street and Fifth avenue is being fitted up with a plant of 280 Julien storage batteries, which will be charged from the street circuit. The Julien Company reports business as very brisk. It is now lighting one of the "vestibule" trains—Chicago Limited Express—on the Pennsylvania Railroad. The effect is remarkably good.

Patents have been granted lately to Max Muthel for a new method of electric lighting by primary battery. The electrolyte is said to be nothing but water. Mr. E. Klaber, 10 Cortlandt street, represents the syndicate that is interested here and in Europe. Such a battery, if it took cheap electrodes, would certainly meet a "long felt want." Up to date, the primary battery that can compete with the dynamo has not been a conspicuous success.

The Edison Wiring Company, lately formed, is based on the business of Noll Brothers, the well-known wiring contractors operating under the Edison system. It has a capital stock of $50,000. The officers are: President, Mr. E. H. Johnson; vice-president, C. Batchelor; treasurer, S. Bergmann; secretary, C. A. Noll; general superintendent, A. Noll. The new company, like the old firm, proposes to do only first-class work, and to use nothing but the best material. Mr. A. Noll will give all its contracts his personal supervision, and it looks to me as though the new departure will prove eminently successful. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, Aug. 15, 1887.

Boston, or to be more specific, the electrical section of it, has quieted down considerably since the electric light men exodusted from the city. Last week was certainly a memorable one in many ways, and the general opinion hereabouts is that the attention it drew to electrical subjects will do permanent good to the industry at large. The presence of such a body of keen, energetic men could not but make itself felt, and Bostonians realize that the electrical field is growing rapidly and attracting some of the brightest minds in the country.

The Gamewell Auxiliary Fire Alarm Company, of Portland, has filed its certificate of organization at the Secretary of State's office. Its business will be the manufacture or supply of fire or other alarms. Capital stock, $250,000; paid in, $300; par value of the shares, $100. President, Albert P. Sawyer, Newburyport, Mass.; treasurer, Geo. W. Piper, Newburyport. Other new corporations reported are the following: Steel Copper Wire Company, of Kittery, organized to manufacture and sell copper and steel electrical conductors. Capital stock, $500,000; paid in, $125; par value of shares, $25. President, Edwin S. Thayer, Sharon, Mass.; treasurer, Warren S. Hill, Hyde Park, Mass.

A special dispatch of Aug. 12 from Biddeford, Me., says: F. A. Sawyer, of Portland, and Col. Steadman, of New York, with Horace Woodman, have negotiated for the purchase of the Biddeford & Saco Gas Company's plant in this city. The money will be paid and the purchasers take possession of the property on Oct. 1. It is understood that the purchase is made for the Traders' Electric Light Company of this city, and that the directors of the company will have charge of the gas works as soon as the property comes into possession of its purchasers.

At a meeting of the Dover, N. H., City Council on August 5, the contract for lighting the city by electric light was awarded to H. W. Burgett, of Boston. The entire city is to be lighted from dark till midnight at an expense of $5,000 to $6,000 per year.

An important meeting of the New Bedford Gas Light Company was held Aug. 5, when it was voted to buy the plant, franchise, patent, etc., of the New Bedford Electric Lighting Company (Thomson Houston), representing $75,000, half to be paid in cash and the other half to be taken in 250 shares of the new company. The gas light stock goes into the pool at $150 and the electric company at $100. The directors of the electric company have voted to accept the proposition, and the consolidation will go into effect at once.

The Skowhegan, Me., Fiberite Company have about completed the repairs on the property recently leased by them for the manufacture of battery jars, and are nearly ready to commence work. Chas. A. Brown, of Portland, will be general manager, assisted by E. A. Heath, of Waterville.

Erie Telephone was stiff last week at 32. Official statement of earnings for June is as follows:

	1887.	1886.
Gross earnings	$50,275.28	$43,986.69
Gross expenses	33,129.53	29,103.61
Net earnings	$17,145.75	$14,883.08
Construction	2,039.45	1,147.47
Earnings above all disbursements	$15,106.30	$13,735.61
QUARTER ENDING JUNE 30.		
Gross earnings	$146,418.66	$130,394.55
Gross expenses	97,905.99	86,942.58
Net earnings	$48,512.67	$43,451.97
Construction	8,656.87	6,700.49
Earnings above all disbursements	$39,855.80	$36,757.48
Surplus after paying dividends	$15,855.80	$12,751.48
Previous surplus	65,485.90	.....
Total surplus	$81,341.70	.....

Subscribers added during June, 62; for quarter, 276. Total subscribers July 1, 1887, 9,998, against 9,139 in 1886.

The Erie Company has settled its differences with the Bell Company with respect to the Northwestern territory of the former. The arrangement is a perpetual contract for the Northwestern division, on a basis of a 30 per cent. interest in that section by the Bell company, upon which it waives all participation in dividends until Jan. 1, 1890. This is considered a very favorable contract for the Erie company. Friends of the Erie figure that, after paying Bell $15,000 and 3 per cent. dividends, the company's surplus this year will be fully $30,000, but the Bell does not begin to receive this until Jan. 1, 1890. On this favorable outlook it is predicted that Erie's dividends will be increased above 3 per cent. by the time payments begin to the Bell.

The Jarvis Engineering Company report the following new work: The Kanawha Electric Light Company, Charleston, W. Va., have ordered a boiler to be set with the Jarvis boiler setting. The Edison Illuminating Company, Rochester, N. Y., have

ordered two more boilers set with the Jarvis setting. The Alameda Electric Light Company, Alameda, Cal., Indianapolis Jenney System, have ordered a boiler set with the Jarvis setting. The New Haven Electric Light Company, New Haven, Conn., have recently ordered a 90 h. p. Armington & Sims Co. engine from the Jarvis company. This is the tenth engine of this make ordered. The New Britain, Conn., Electric Light Company have ordered a boiler set with the Jarvis setting to burn screenings for fuel. The Hutchinson, Kan., Water, Light and Power Company are setting two boilers with the Jarvis setting, and will use slack coal for fuel.

The Boston Battery Company has been started here at 51 State street, Mr. G. H. E. Trouvelot, manager, to assume charge of any style or form of galvanic battery that may be in use in the city. This company has acquired the services of a professional electrician and corps of assistants, for the purpose of putting in and caring for all forms of batteries by the quarter or year. By making this branch of electricity a specialty, more reliable efficiency at a much less cost to the public is insured. The company will pay attention to all classes of electrical work, and should meet with success in carrying out its excellent idea.

Last Thursday a carpenter named John W. Bettison, while raising the frame of a new building on Wheatland avenue, Dorchester, Mass., found his work obstructed by a wire. Without stopping to inquire its use or the consequences of his action, he cut it with a hatchet. It was a fire alarm telegraph wire, and the severed ends fell upon the wires of the Western Union Company, grounding three circuits, besides rendering useless one of the fire alarm circuits. The Fire Commissioners had Bettison arrested, and he was fined $5 and costs.

I take the following note from the Providence *Journal:* The Armington & Sims Engine Company have purchased the Paine & Sackett mill on Eagle street for a sum less than $100,000, and have begun to remove their machinery here. The Armington & Sims Company, which came to this city from Lawrence, Mass., in 1882, and established their works at 546 High street, have gained a world-wide reputation for engine building, especially for electric lighting purposes, their machinery being peculiarly adapted for furnishing power of a kind demanded by this industry. The distinctive qualities of their engines are high speed and perfect regulation. Since the establishment of the company here the business has increased to great proportions, until now the Armington & Sims engine can be found in almost every city of the country and in several abroad. Some time ago it was seen that the High street establishment was inadequate to the increasing business, and the company determined to purchase the Paine & Sackett mill, which was offered for sale at very attractive figures. During the past year more orders have been received than could be filled, even while restricting the supply to engines for electric lighting purposes. The recently purchased property on Eagle street, a large four-story brick structure, is very well adapted to the needs of the engine company, there being ample room and land to erect monster roofed sheds outside the main building, which will enable the company to branch out their business to the proportions contemplated. That is, besides furnishing for electric purposes, they anticipate making large engines for manufacturing purposes, as even now orders are received for them and they cannot be provided until the works are removed. This morning a $25,000 order was received from New York. The company began removing their machinery this morning to the new quarters, and the work will be continued gradually, so that the production will not be checked to any great extent before they are fairly prepared to meet the demand in the new location. The machinery for the manufacture of woollen goods now in the mill is being taken out, and the building placed in readiness for the new occupants.

W. I. B.

PHILADELPHIA NOTES.

PHILADELPHIA, Aug. 15, 1887.

It now transpires that the aim and object of Chief Walker, of the City Electrical Department, and an idea that is looked upon favorably by the Mayor and Director of Public Works, is to establish electric lighting plants to be owned and operated by the city. For a long time Chief Walker has been working on the project. He has made experiment after experiment with underground wires, and has consulted the plans of the city with respect to the establishment of plants, the laying of conduits and wires, until he could almost draw a correct map of Philadelphia with his eyes closed. While he has been working long and hard, he has still been working secretly, and has given no sign to the public of the good things that are in store for them.

Although the main points of the great project have leaked out, the Chief is still mum. "Until I have completed all my plans and submitted them to my superiors," he said, "I will not give anything out. I can assure you that there will be a good deal in the way of news in this connection before long, but just now I do not care to give it out. In two weeks probably I will be ready to do so, but I cannot think of it at this time.

"I will say, however, that my plans are for the purpose of having the whole city lighted by electric lights, and I am confident that before many months have passed this thing will be in operation. Further than that I do not care to talk at this time."

Some practical experiments that the Chief has been making are seen on North Broad street. Ever since the scheme of placing the electric light and other wires underground has been broached, the companies owning such wires have set up as an excuse for not complying with the wishes of the people the statement that it is impractical to put electric light wires underground.

Over $100,000 was appropriated by the city last year for electric lighting. The companies doing the work embrace those which have been in operation here for the past year, and their wires are on all the principal streets.

A great deal of underground work has been done by the city in various sections, but it must be remembered that much has also been done by the electric light companies, although the major portion of it has been incandescent work. Therefore the excuse that the city wishes to control its own plant in order to get wires underground is not regarded by those interested as a valid one. The private companies are just as willing and ready to put their lines beneath the surface as is the city, but they want an underground system that is a practical success, and thus far, they say, have been unable to find it. Then, too, they can hardly afford to lavish money in experiments, as the city can.

The wharf at Otis street which has been used as a pumping station to the Kensington reservoir, will soon be available, as the pumping station has been abandoned, and as a large rolling mill concern has been anxious to secure the piece of wharfage and has met with much opposition on the part of the city, it is no longer a secret that the place is wanted for the establishment of an electric light station, as one of the plants to be erected in accordance with Chief Walker's scheme, which will embrace several central stations.

"If all goes well," Chief Walker said to-day, speaking on this head, "the station in Kensington will be ready for operation by the first of the year. Our idea in getting near the wharf is that we can thus secure coal and supplies without paying for cartage. The wharf in question is admirably adapted for our needs. There is a five hundred horse-power engine there already, and storage place for fifteen hundred tons of coal. Then there are tracks and scales, and all that will be needed to start the station will be to put in the dynamos and the leads to them. By the aid of condensing engines which we will put in, and the use of boilers, we will be able to run eight hundred lights from that station.

"The next step would be to secure a place on the Schuylkill River, somewhere between Callowhill street and Washington avenue, for a similar station, and then, with these two, the city could be pretty well lighted. The reason we want to locate the stations near the river is that they can there be run at a minimum cost to the city. Being by the water we can use condensing engines and a cheap quality of coal, and, as has been said, we will not have to pay the expense of cartage. As every underground company that has received privileges from Councils is obliged to furnish, in addition to the compartments for their own wires, space for not less than three wires for the city, one for electric lighting, one for telegraphic and one for telephonic purposes, the cost to the city for putting the wires underground will not be much. We want space and power enough for 1,500 lights.

"We now have in use 527 lights nightly, and they charge us 55 cents each. In New York the price charged by the companies is but 25 cents a light, but that is because of the fight over there."

"And what do you think it would cost the city per light if it operated its own plant?"

"I wouldn't like to make an estimate hurriedly, but I should say the cost per lamp would be about 30 cents a night. However, I will not have the details ready for some time yet." The plan is now being discussed pretty thoroughly in the editorial columns of the daily papers, and a résumé of what has been said shows that it does not meet with much favor. The most general argument is that the city now owns its own gas plant, and, while various syndicates have offered a million dollars per year rental, besides a bonus of half a million for their use, the gas works, under the management of the city, are under a heavy load of debt. That they do not pay is beyond question, and it would seem that the city should keep out of all business which can be done as cheap or cheaper by private persons or corporations. The city is entitled to every benefit that it can gain in a legislative way, but there it should stop. The electric light is the light of the near future, no doubt, and it will be well for the city to see that it secures every possible privilege, but the people have had enough of the city's trying to undertake commercial business by taxing everyone for what all do not want or enjoy.

A dispatch from Asbury Park says: "The first car of the Seashore Electric Railway has come, and yesterday, as it stood on the siding, was visited by many people. The car resembles an ordinary open street car, such as can be seen in any large city. In the centre beneath is a large chamber where the electrical apparatus is placed. "Seashore Electric Railway" is painted on the side, while below are the words "Daft Electric Motor." The cars will be lighted by three incandescent lights, and hold forty-five persons comfortably. Another car will arrive to-day, and will run in all probability by Saturday."

The annual convention of the "Old Time Telegraphers" occurs in this city next week. The members will be received in Independence Hall by William B. Wilson, of this city, and an address will be made by David Brooks, member of the organization. The business meeting will then be held, and on Thursday they will visit the various points of interest in the city, while in the evening a banquet will be given at the Union League Club-house. The society ranks among its members nearly every person who was in the military as well as civil service of a quarter of a century ago, although many of them, such as Andrew Carnegie, ex-Governor Bullock, of Georgia, ex-Gov. Cornell and others have passed into other walks of life, while those who still remain among the craft as active practitioners have reached its highest pinnacles.

E.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, Aug. 13, 1887.

Mr. Woolley of electric headlight fame is out with an oil engine for running small generators. He claims that it requires no attention after being once lighted and that a great saving is effected in cost as compared with gas.

The iron towers for electric conductors referred to in my last week's letter are being manufactured by the Star Iron Tower Co., of Ft. Wayne, Ind. The specifications call for a height of 30 feet above the highest buildings.

While in Fort Wayne this week I noticed that the electric light company there are using crude oil for fuel. The oil is brought in tank cars from Lima, O. The Fort Wayne Jenney Electric Light Company have contracted with the Mutual Electric Light Company of Chicago for five thousand incandescent lamps. The Mutual Company will do general lighting from a central station.

The City Council at Detroit, Mich., has been trying to force the local Brush Company to go underground, and as passing ordinances has had no effect, the city has begun suit against the company. The Brush Company allege that it is not practicable to lay their wires underground, and the city will endeavor to show the contrary. The city authorities do not seem aware of the difficulties connected with underground high potential circuits. Mr. McGrath, the city attorney, has been in the city for several days for the purpose of getting evidence. Affidavits were secured from several, among the most important being one from Mr. Cushing, Superintendent Chicago Arc Light and Power Company, affirming the use of underground wires sufficient to give service to nine hundred arc lamps.

The Chicago Arc Light Company continue work upon their new quarters. Mr. Cushing states that the building is peculiarly adapted for central station purposes. In transmitting power from one section of the building to another a rope running upon grooved pulleys will be used instead of a belt.

A company called the Chicago Electrical Development Company, 171 Randolph street, has been formed here for the purpose of placing inventions of merit upon the market. The company has advantages, it is claimed, which will enable it to accomplish this result speedily and with good assurance of success. Patents and inventions will be bought outright for articles manufactured or sold on royalty.

The river lighting contract has finally been awarded to the Western Electric Company, the Fort Wayne Jenney Electric Light Company filing a protest. This contract was the largest ever given in Chicago, and while the award was not a surprise, it was eagerly hoped for by all the bidders. That the Fort Wayne Jenney Company did not get the contract was due, it is said, to a misunderstanding, or rather, to a point that was not made plain until after the contract was awarded. Whatever the reason, the suspense is over, and the Western Electric Company will have the opportunity of demonstrating what a low tension current can do through such a long mileage of submarine cable.

I had the pleasure of an interview with Professor Barrett, the other day, and he stated that while he was glad that a home institution received the contract, it was awarded to the lowest bidder without reserve. When the first specifications were sent out only a few engines were named, "but," said the Professor, "a small army of engine men from all the States and territories came to my office to convince me that each one of them had the best engine made. So I called in the specifications and sent out notices that any engine with the required efficiency would answer."

There is always something interesting to report about the motor business. Chicago electricians are particularly proud of the Van Depoele Electric Manufacturing Company, who have equipped within the last few years a large number of street railways in the Eastern, Southern and Western States. This company has undoubtedly done as much to educate the public in the many ways in which electricity can be utilized as any other concern in Chicago. The Van Depoele Company have asked for a franchise from the Lake View City Council to run overhead wires from Diversy street north six miles. The company agrees to go underground in one year. If this line proves satisfactory to Mr. Yerkes, the president of the North Side system of street railways, he will adopt the Van Depoele electric railway upon other lines.

The Van Depoele Company have closed a contract with the Omaha Motor Company for twenty motors and two 150 horse-power generators.

Mr. Chas. Desmond, late in charge of the electric plant at the Palmer House, will have charge of the electrical machinery at the Milwaukee Exposition.

The Excelsior Electric Company's plant at the new cable railroad building on the south side went into operation this week, giving from the start general satisfaction. Arc lights are used in the large areas and incandescents for other lighting purposes, all being run from the arc light circuit. The incandescent lights are carried out from the main building beneath the surface of the street affording light for oiling and repairing the large wheels and other machinery.

I understand the Westinghouse Company will not establish an agency here at present. There was some talk that they would do so a few weeks ago, but the above is from the best authority.

Mr. Jno. R. Walsh, the Chicago banker, named as one of a syndicate of capitalists forming a combination of telegraph interests in opposition to the Western Union Company, denies all connection with the enterprise.

The Electrical Construction Company, at 171 Randolph street, are the pioneers in their business in this territory. The company give attention to all kinds of construction, from a push-button to a telegraph line. They are also prepared to install arc and incandescent plants, Mr. Harter, the manager, having a large experience in electric lighting.

In order to thoroughly appreciate the condition of the telephone stock market it is necessary that one be conversant with the causes that have led to the present situation, and this includes manipulations and schemes extending back several years.

The intensity of the desire of small capitalists and others for holding telephone stock a few years back is equaled by the aversion these same people display toward these stocks now. There is no opportunity now for "doubling up," simply because there are none to buy. Notwithstanding the heavy capitalization of these companies, however, several of them are netting from five to ten per cent. upon their total capital stock, and yet are selling from 40 to 70 cents on the dollar. Colonel Lynch states that nothing can be done until the decision at Washington is made public.

The Chicago telephone exchange certainly presents a problem for electrical engineers. All of the city wires must be underground, and good service cannot be expected by using the underground work necessary for a multiple system with one or even two exchanges. That the service is bad is admitted by every one, but no one suggests the remedy. It is already extremely difficult to talk from a point below Polk street, on the south side, to any part of the north side.

My Indianapolis correspondent sends me the following: A company styled the Canadian Telephone Register Company has filed articles of incorporation and will establish a manufactory here. The company is headed by Charles Wittenberg, of this city, who is the inventor. The device, which you have already noticed, can be attached to any telephone. By dropping a nickel in the box connection is made with the exchange; if the desired connection is made by the exchange the call is registered, if not the nickel is released and no call registered. This contrivance is somewhat similar to the box recently brought out by St. Louis parties.

Considerable damage has been done to telephones in the past week by lightning, forty-five instruments having been burned out here in one day.

The Indianapolis Brush Electric Light Company are negotiat-

ing for a larger building, having outgrown their present quarters If they are successful, they will have room for increased facilities, and will do all their own repairs.

My Wichita, Kan., correspondent sends the following: Wichita Kan., is an electrical boomer as well as a renowned boomer on general principles. Little over a year ago it was unknown to the electrical world, to-day it is the happy possessor of two electric light installations, one electric railway, electric fire alarm, A. D. T. service and a small army of bell hangers, to say nothing of the *et cetera*. The Thomson-Houston Company operate 120 arc lamps, and the Schuyler Company 275 arc and a number of series incandescent lamps ranging from 16 to 60 c. p. The Wichita Electric Railway Company have completed three miles of track, power house and overhead conductors. They will begin operations by Aug. 15, using Brush generators and "home-made" motors. The telephone exchange has grown so rapidly that the company have decided to move into more convenient quarters, and are reconstructing with that end in view. Several thousand feet of cable will be used to convey the lines into the new "central."

I hear from Denver, Col., that the electric railway of that city is experiencing some trouble with the conduit circuits.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes me the following quotations upon telephone stock:

Bell of Mo.	$155@$157
Central Union	44@ 45
Chicago	385@ 400
Colorado	20@ 22
Cumberland	80@ 85
Great Southern	30@ 33
Iowa Union	25@ 27
Michigan	75@ 76
Rocky Mountain Bell	40@ 45
Wisconsin	105@ 107

C. H. M.

MISCELLANEOUS NOTES.

New York City.—The Hewes & Phillips Iron Works of Newark, N. J., have just contracted with the Thomson-Houston Electric Company for a 750 h. p. compound condensing engine for the new station to be built in this city.

The Field Electric Locomotive.—Mr. S. D. Field has sent down to this city from his factory at Yonkers an electric locomotive, which will be given a trial on the Thirty-fourth street branch of the New York Elevated road. The general design of the locomotive is Mr. Field's, and the motor is that of Mr. Rudolf Eickemeyer.

An Edison Convention.—The Edison Association held its meeting on Aug. 11 at Altoona, Pa. It was well attended, about 75 delegates being present, representing some 40 local lighting companies. The proceedings were highly interesting and instructive. As usual, the convention sat with closed doors.

BUSINESS NOTICES.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolts, cap and set screws, taps, dies, files, twist drills, brass and rubber in tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

Electric Hand-Lighting Gas-Burners.—The following important announcement is made by Mr. A. L. Bogart, of this city, and the Electric Gas Lighting Company, of Boston, who have formed a trust in regard to electric hand lighting gas-burners: "Notice is hereby given that the undersigned have become the owners of U. S. Letters Patent—to Wm. A. Pitt, No. 139,811; A. T. Smith, reissue No. 7,249; A. L. Bogart, No. 180,832; A. L. Bogart, No. 180,833; A. L. Bogart, No. 202,694; J. P. Tirrell, No. 232,661; H. A. Packard, No. 225,071; F. V. Sandford, No. 232,304; and an undivided interest in Heyl and Diehl, No. 116,044; and the sole interest in E. E. Bean, No. 108,434, relating to hand-lighting apparatus; that said letters patent control and cover all varieties of electric hand-lighting burners in which the gas is both turned on and ignited by a primary spark, at a single movement by hand; by operating both gas-cock and electrode, directly or indirectly, by the key of the gas-cock, whatever its form, or by an angle lever and bar, or by a ratchet wheel whose revolution brings the electrodes in contact, and alternately opens and closes the gas-cock; and also all forms of simple lighters in which, by means of a bar, chain, or thumb-cock, a movable electrode is brought into contact with a fixed electrode; and those in which the movable electrode is withdrawn from contact by means of a spring or its equivalent. Notice is further given that no corporation, firm or person is authorized to manufacture any of these varieties of apparatus, except the undersigned, and the Boston Electric Company, of Boston, as sole licensee of the undersigned; and that every manufacturer of such apparatus, and every purchaser or user of the same made by other than the said parties, will be exposed and prosecuted by the undersigned conjointly under such and all of said letters patent as may be so infringed. The peculiarities in form and style of the respective apparatus made by said parties will be preserved by them hereafter and sold at reasonable prices, and each burner will bear the stamp of its manufacturer. Dealers will note that such apparatus only as shall be so stamped and obtained from the authorized manufacturers, or the purchasers, can be safely sold. The purchase by the undersigned of the above letters patents has been compelled by the hardihood of infringers who have profited by litigation between owners of letters patent of undoubted validity, but undetermined relative scope, to infringe the rights of both parties. Personal notice will be sent to all our customers and to known dealers, but they and the public generally are hereby notified that infringers of any of the above letters patent will be proceeded against according to law."

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED AUGUST 2, 1887.

367,359. Galvanic Battery; H. J. Brewer, of New York, N. Y. Application filed Aug. 2, 1886. Evaporation of the liquid is prevented and the electrodes are held securely to the bottom of the jar.

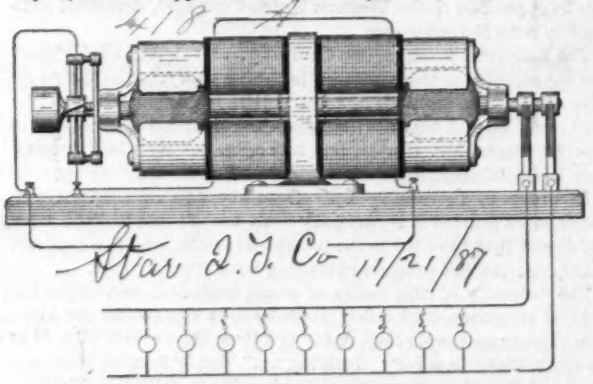
367,422. Electrical Ore Detector; L. Mellett, Milford, Mass. Application filed March 10, 1887. This device is designed particularly for use in dragging the bottom or bed of bodies of water with grappling hooks, in search of metallic articles, such as chain, anchors, etc. When the cable comes in contact with a metallic article a circuit is completed and an alarm sounded above water. See illustration.

367,402. Electric Pyrotechnics; J. H. Irwin, Morton, Pa. Application filed Jan. 23, 1882. Electric incandescent lamps are arranged in various figures, and by means of a switch the lamps are flashed in rapid succession.

367,435. Lightning Arrester for Protecting Oil Tanks; D. O'Brien, Philadelphia, Pa., Assignor of two-thirds to John O'Brien and E. E. Weaver, both of same place. Application filed March 8, 1887. A balloon carrying lightning collectors and conductors leading to the earth.

367,451. Galvanic Battery; J. Serson, of Boston, Mass., Assignor, by direct and mesne assignments, to the Uncle Sam Electric Light and Battery Co., of Portland, Me. Application filed Oct. 14, 1886. A tight inclosing tank, a porous inner jar having several vertical concentric walls with pockets on the outside of its outer wall.

(1) 367,469. System of Electric Distribution; (2) 367,470. Regulator for Dynamo-Electric Machines and Motors; (3) 367,471. Coupling Compound Dynamo-Electric Machines; Elihu Thomson, Lynn, Mass. Applications filed respectively Aug. 30, 1884, April 14, 1886, and June 4, 1886. (1) Means whereby a high tension current on a main circuit supplied from a suitable source may be utilized in developing current of low tension on one or more local circuits electrically insulated from the main. See illustration. (2) The aim of the invention is to provide a regulator in which the commutator brushes shall be automatically adjusted to exact correspondence with the changed neutral line produced through change in the magnetic field. (3) Dynamo machines connected in multiple arc and each maintained in part by a branch from the field-coil circuit of the other, and an intermediate switch having connections whereby each machine may be made to feed its own field coils only in multiple arc.



367,469. SYSTEM OF ELECTRIC DISTRIBUTION.

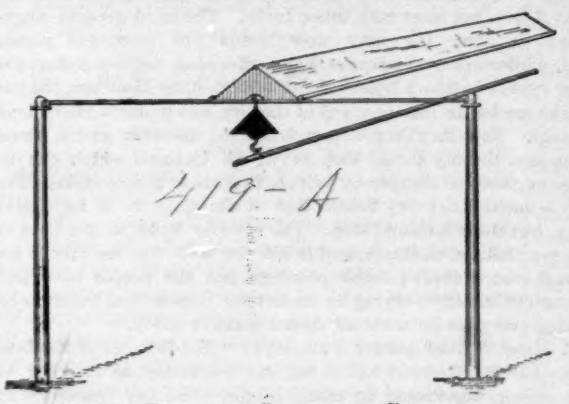
(1) 367,475. Roof for Suspended Electric Conductors; (2) 367,685. Electro-Magnetic Railway Brake; C. J. Van Depoele, Chicago, Ill. Applications filed respectively March 12, 1887, and Feb. 8, 1887. (1) This is a continuous roof for the conductor of an electric railway, supported by the cross wires which support the conductor. See illustration. (2) A solenoid is used to draw in a plunger, thereby operating the brake mechanism.

367,523. Burglar Alarm; B. F. Hough, of Sandusky, Ohio. Application filed Oct. 30, 1886. Structural details.

367,541. Electric Ore Indicator; L. Mellett and J. Prince, Milford, Assignors to said Mellett and George Reed, of Fitchburg, Mass. Application filed March 24, 1886. See brief of No. 367,422.

367,548. Electric Conductor; T. S. Reed, Bridgeport, Conn., Assignor to the Bridgeport Brass Company, of same place. Application filed June 8, 1883. The naked surface of the conductor is coated with a non-siccative paint and the whole is covered by a fibrous covering which is permeated with the paint.

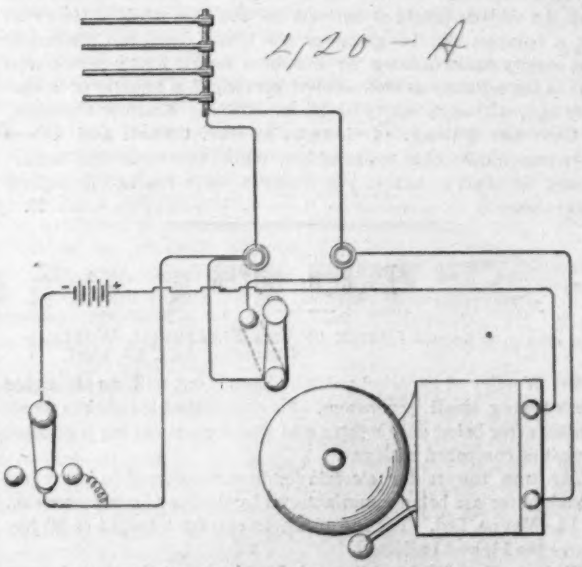
367,568. Electric Arc Lamp; M. J. Wightman and H. Lemp, of Hartford, Conn., Assignors to the Schuyler Electric Manufacturing Co., of Conn. Application filed Oct. 26, 1886. The carbon or carbon carrier is subjected to the sole action of a derived circuit magnet acting in opposition to a suitable retractor.



367,475. ROOF FOR SUSPENDED CONDUCTORS.

367,598. Electric Railway Signal; E. M. Chase, Boston, Mass. Application filed Nov. 9, 1886. Double inclined levers actuated by the impact from a passing train, and time bellows operating to retain said levers inactive, with a magneto generator and its driving mechanism likewise operated by the same impact to excite magnets controlling visual signals.

367,627. Electro-Magnetic Car Brake; J. Herrington, Sharon, Pa. Application filed March 30, 1887. Besides the motor for operating the brakes, means are provided for automatically establishing circuit when cars are coupled and for closing the circuit between the wires of each car when the cars are separated.



367,422. ELECTRIC ORE DETECTOR.

367,630. Electric Distribution by Secondary Batteries; W. Hochhausen, New York, N. Y. Application filed June 21, 1883. The object is to provide a system wherein the generative capacity of the dynamo machine may be utilized in the day time as well as at night, when the lights are required for use.

367,650. Electric Type-Writer; J. F. McLaughlin, Philadelphia, Pa. Application filed Nov. 23, 1886. An electro-mechanical receiving instrument comprising a series of fulcrumed type levers carrying respectively the desired types or symbols, with electro-magnets for actuating the levers, a local circuit, including spacing mechanism, and a suitable circuit changer operated by each of the type levers. See illustration.

367,651. Electric Motor; A. W. Weston, of St. Louis, Mo. Application filed Feb. 13, 1886. Automatic means for changing the position of the brushes with reference to the field magnets.

367,663. Electric Programme Clock; A. J. Reams, Augusta, Kan. Application filed March 7, 1887. Structural details relating to secondary clocks.

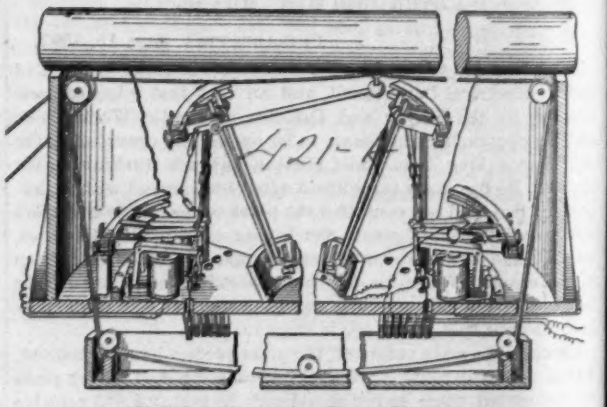
367,670. Electric Light Switch-Board; C. E. Scribner, Chicago, Ill., Assignor to the Western Electric Co., of same place. Application filed March 13, 1885. This invention is to be used where heavy currents are in operation. All parts of the board and plugs are insulated to protect the operator.

367,705. Galvanic Battery; P. R. De F. d'Humy, London, England. Application filed Nov. 12, 1885. Two electrodes are employed in direct combination with pure water.

367,720. Printing Telegraph Receiver; H. Mahnken, Brooklyn, Assignor to the Commercial Telegram Company, of New York, N. Y. Application filed Nov. 6, 1886. The two type wheels are arranged outside of the frame carrying the power trains.

367,730. Cable Rack for Switch-Boards; J. A. Seely, New York, N. Y. Application filed Jan. 31, 1887. This device permits the ready removal of a section of the spring jacks from one board to another without making disconnections.

367,731. Deposition of Platinum by Electricity; W. A. Thoms, London, County of Middlesex, England, Assignor to the Bright Platinum Plating Co. (Limited), of same place. Application filed Aug. 31, 1886. By this process of plating the plate needs no polishing after removal from the bath.



267,650. ELECTRIC TYPE WRITER.

367,734. Terminal for Electric Cables; R. H. Widdecombe, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed Aug. 16, 1886. An air-tight box provided with separate insulated binding posts. The device excludes moisture.

367,754. Telephone Exchange Apparatus; W. M. Goodridge, Highland Park, Assignor to the Western Electric Company, Chicago, Ill. Application filed March 4, 1887. A multiple switch-board system with telephone lines, each provided with a separate switch on each section of the board, and on one of the sections in each line an answering spring jack, an annunciator and an extra spring jack, and a flexible cord with its terminal plug normally inserted in the extra spring jack of its line, the plug on being removed taking off the ground, and, on being inserted in the switch of another line, serving to connect the two lines together.

367,768. Conduit for Electric Wires and Cables; George D. Sutton, New York, N. Y., Assignor to George D. Sutton, Jr., of same place. Application filed Aug. 5, 1886. Convenient means for making lateral connections to the conductors.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patens issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.